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GEODETIC WORK IN SPITZBERGEN.

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DURING the early years of the seventeenth century, the question of the figure of the earth was one of great prominence. The geodetic work of the Cassinis, under the auspices of the Academy of Sciences of Paris, served to show that the earth was prolate; that is, the polar axis greater than the equatorial, while the theoretical discussions of Newton and Clairaut pointed to an oblate, or flattened, earth.

The behavior of a clock that had been taken to the equator for astronomic purposes proved that gravity was less there than at Paris, or that the latter place was less than the equatorial radius from the earth's center. However, the partisans of the prolate hypothesis would not yield to a single observed fact, and cleverly pointed out that centrifugal force being at its maximum at the equator, the pendulum ought to be slower there than at places nearer the axis of rotation. They did not allow themselves to be disconcerted by the answer that the discrepancy was greater than could be accounted for by assuming the earth prolate or even spherical.

While this contest between the two camps was going on, new experiences with the pendulum were reported, incidentally with the reports of astronomic expeditions, and all were confirmatory of the Newtonian view. The French Academy, piqued at its inability to convince mankind by the geodetic work already prosecuted under its direction, determined to settle this mooted question by measuring an arc at the equator to see if degrees increased in length in that direction, as they affirmed, or grew less conformable to the requirements of their opponents.

The ease with which the means for this expedition were obtained prompted Maupertuis to urge the sending of an expedition northward to prosecute similar work within the Arctic Circle. The field of operations selected was the head of the Gulf of Bothnia. It was not difficult of access, and the maps showed numerous islands favorable for triangulation with suitable sites for bases on the mainland. A careful examination of this locality, however, revealed the fact that the islands would be of no service in the triangulation, so it was necessary to go inland in search of ground fit for base-measuring, as well as for points or mountains well located for triangulation stations.

The point next in view was Tornea, a small town at the mouth of a river of the same name, which in its southward course passed through a valley skirted by two parallel ranges of mountains. Here good locations for triangulation signals were found, but there was lacking a straight stretch of level ground for a base line. It was proposed that they wait until winter and measure their line on the ice over the river. The plan appeared so feasible that a reconnoissance was at once begun. This work was attended by many hardships—wading through marshes which in many places lined the river, penetrating the thick undergrowth around the foot-hills, and climbing precipitous mountains—all the while pursued by gadflies of the most tormenting kind.

Maupertuis' work, prosecuted under such trying circumstances and partly during the rigors of an Arctic winter, did not bring the proof expected, in fact it over-reached itself to the extent of justifying the remark that "he flattened the earth and the Cassinis." But as the pioneer worker in the Arctics, he won great honors. He was even called by Frederick the Great to Berlin to "put the Academy of Sciences into shape and to graft into this wild crab tree the graft of the sciences." The invitation concluded with the flattering words: "You have shown the figure of the earth to mankind, show also to a king how sweet it is to possess such a man as you." Parenthetically it might be said that he at least succeeded in grafting into the Academy the French language, which explains why the early memoirs are not published in German.

In the years immediately following his return to Paris, he was under the constant fire of critics. They assailed him because he had neglected refraction; they taunted him with having omitted to consider errors of graduation; and his results were declared valueless because he disregarded the shortening of his base bars in the low temperature in which he did his measuring. In short, no two persons were agreed as to the complete catalogue of shortcomings in Maupertuis's arc. But when each one applied his correction, the length of the arc did not appreciably shorten. By way of retaliation he turned his attention to the work done in France. He applied corrections which had been ignored, but even then he had the earth too flat to fit theory. His experiments with the pendulum strengthened his general conclusion that the earth was oblate. Several years later the equatorial party returned, and their work proved conclusively that the degree shortens in going toward the south, or that the polar axis is the shorter.

Notwithstanding the shortness of the Lapland arc, it has contributed data for all the principal discussions regarding the shape of the earth as deduced from geodetic measurements. In the early years of the present century, the arc was extended by the Swedes and made of greater value also by the use of refinements and precautions that were unknown fifty years before.

The value of Arctic geodetic material was recognized early in the history of the science, but because of the difficulties attending such work in high latitudes and the absence of available land areas in the polar regions, nothing has been done in addition to the two measurements referred to.

Sabine while with Parry on his famous Arctic expedition of 1819, made pendulum observations of great value, his most northerly station being in latitude 79° 49'. He was impressed by the freedom of the waters on the west of Spitzbergen from ice and concluded that for many reasons the island would afford a suitable site for an arc measurement. The many deep inlets would greatly assist in reaching interior points, inasmuch as overland travel would be difficult and tedious. On his return he proposed to visit this region again for the purpose of making a careful examination with a view to its availability for degree determinations. From Ross Island on the north to Hope Island on the south is a possible arc of four and a half degrees; this he deemed of equal value to an arc of seven degrees in Great Britain or nine degrees in the mean

WRECK OF ANDRÉE'S BALLOON HOUSE, SPITZBERGEN.

PENDULUM OBSERVATORY, DANE'S ISLAND.

THE COAST OF SPITZBERGEN.

latitude of France. He did not regard the climate as offering any serious obstacle, and was so confident of an easy reconnoissance that he volunteered to make the attempt if accompanied by a brother officer and a single sergeant. His plan was submitted to the Royal Society in 1825 by Sir John Herschel and warmly seconded by its president, Sir Humphry Davy, and others. The general scheme was indorsed and steps taken toward carrying it out when Sabine was detailed for other duty.

The matter, apparently lost sight of for several years, was next taken up by Torrel, of Sweden, who in 1860 succeeded in inducing Prince Oscar and the Swedish Diet to make a grant in aid of scientific investigations in Spitzbergen. A part of the work laid out was a geodetic reconnoissance to be prosecuted by Duner and Chydenius.

In the summer of the following year, the expedition reached Amsterdam Island, where the vessel was caught in the ice and detained so long that only a small part of their plan could be carried out. They, however, came to the conclusion that no impediment existed that could prevent the carrying of a triangulation from Ross Inlet to Amsterdam Island, but that the mountains surrounding Magdalena Bay are so steep and difficult of access that the continuation of the survey southward would be, if not absolutely impossible, at least so difficult, and would entail such heavy expense, that its execution along that coast would probably never be carried into effect.

Chydenius, who explored the northern portion, was more fortunate, at least in not being caught in the pack. But because of great masses of drift ice, he found his task extremely difficult and sometimes rendered dangerous by the many glaciers that were continually breaking off at the water's edge. He found on Low Island, just west of Treuenberg Bay, a site for a base line, and selected in that region several stations. The general scheme was laid out, but on account of the imperfect maps, some of the stations were thought to be accessible by water, when in fact we now know them to be far inland. As was common at that time, the regions not visited were described as high table land with numerous mountain peaks lifting their undefined heads above the mist and fog. The conclusion of their investigations was: "There are well-founded reasons for thinking that the whole arc will be found measurable." Immediately upon the receipt of this report, the Swedish Academy of Sciences, deeming this work of great importance, petitioned the government for the means for executing it along the lines proposed.

In 1863 the Diet unanimously voted to make a grant of 40,000 kroner for this purpose, and Nordenskiold was put in charge of the expedition. Although he started from Tromsoe, latitude 69°, on the first of June, he did not reach the first mountain to be climbed until the 9th of August, and during the entire season he succeeded in making only five ascents, Mount Walrus, in Storfjord, being the most northerly. At this time geodetic work was prominently before the scientific world. The arc from the Danube to Hammerfest was just completed, the arc of parallel from the west coast of Ireland to the mouth of the Ural had been begun, and the Palermo-Trondhjem arc had been decided upon. All this made it easier to secure the needful assistance for the work in Spitzbergen, but when such meager results were accomplished with the 40,000 kroner, it was difficult to convince those in authority that the plan could be carried through without an expenditure disproportionate to the ends to be achieved.

Nordenskiold reported that the warm waters of the Gulf Stream coming into contact with the colder air of the west coast of Spitzbergen caused heavy fogs to rest over that coast from June to September, so that the triangulation would have to be done between September and June. He might have added that since the reconnoissance must concern itself with the intervisibility of the signals, that work too could only be done between the dates named.

Within the last few years the project has been revived by Rosén, the distinguished chief of the Swedish Geodetic Survey. Accepting the maps of Spitzbergen as reasonably accurate, he has laid out a scheme of triangles extending from Ross Island on the north to South Cape, giving an arc of 4° 23' of amplitude. In his opinion the chances for success now are greater than they were thirty years ago. This is partly because the better knowledge of the geography of the islands has caused the abandonment of the plan that relied upon hypothetical inlets for means of reaching interior stations. The whole chain as now projected is to the east, with stations on both sides of Henlopen Strait, with that body of water to serve as a means of communication. Then, too, the elaborate series of meteorological observations made by Nordenskiold while in charge of the International magnetic observatory at Cape Thorsden has given a large amount of valuable information regarding the climatic conditions to be expected at each season and the most favorable time for each phase of the work to be accomplished. It has been found that for the month of June the average temperature is —6° C., rapidly increasing during July from 0° to as much as 12°. This rather high temperature, with the sun shining all day long, melts the snow very rapidly, causing innumerable avalanches and deep streams along every valley. The air is foggy, as said before, and storms with heavy rains are frequent. This has confirmed the suggestion that most of the work must be done in the spring and early winter. The objection to this plan is that one or more winters will have to be spent in Spitzbergen—the very thing that was thought could be avoided by selecting this locality for an Arctic arc. But in any event, if the work is to be carried on later than August, it will not be possible to get away, or if it is to be begun before July, the island cannot be reached.

Of course there is nothing impracticable in the plan to winter there, but the dreariness of the 126 mid-day nights would deter many from accompanying such an expedition. Another weak point in the scheme is that Storfjord must be traversed to reach some of the stations, and the experience of the seal hunters is that this fjord is free from ice only once every three years. Then too the treacherous Henlopen Strait is the principal thoroughfare. Because of its unexplained currents, this is a most uncertain body of water. The entrance may be free from ice one day, and completely closed up the next, and unless a favoring wind springs up, it may stay closed for the entire season. Scores of boats have been caught in this trap and forced to escape by sailing entirely around West Spitzbergen, if that passage is open, or spend the whole winter there if this channel too is closed.

The wisdom of selecting one of the Seven Islands for the northern terminus is questionable, since the certainty of reaching them is never assured. It was against one of these islands that Wellman's steamer was crushed in 1894, but on the other hand, last summer they were visited by three parties without any serious difficulty.

Only one station is as much as eight miles inland—a wise precaution when it is realized what sort of ground must be traversed when the ice foot is left. Little is known of the interior of Spitzbergen. The maps say, for lack of definite information, that it is an extensive ice-cap, but Sir Martin Conway in his crossing found a succession of irregular chains and peaks similar to what we see on the west coast. And last summer Baron van den Haersolte van den Doorn, starting in a little farther north, saw, after reaching an altitude of 1,200 feet, sharp mountains, of varying altitudes, in all directions. It is therefore by no means certain that any projected line of sight across a portion of this region will be found possible, and the reconnoissance so far has not tested the intervisibility of all the contiguous stations.

The scheme as now adopted includes 22 triangles with two base-lines, one near each terminus of the arc. It is proposed to measure the bases with the Jäderin wire apparatus, and the angles with 20 cm. theodolites provided with reading microscopes. In the base measuring an error less than 1:100,000 is to be expected, and by making ten pointings the errors in angle determinations will lie between 0·5" and 0·7". Latitudes will be determined from circum-meridian distances within 0·2", and if the suggested arc of parallel should be attempted, differences of longitude will be ascertained by the transportation of chronometers.

It is thought that a station can be finished in nine hours, of which two are to be devoted to the measurement of horizontal angles and four to the determination of time and latitude.

A part of what has just been said rests upon speculation, or at best upon experiences under similar conditions. However, other elements of the problem were examined in situ last summer by a joint Swedish-Russian party, of which Mr. Jäderin was a member. They visited a number of the out-lying stations in the north, and when I saw them in July at Ice Fjord, they were confident that the entire scheme can be carried out. They are to start on their return early in May of this year, to take up the final stages of the work. Whether they will find the conditions as favorable as they were last year or not, is a question that can be decided only by trial.

The prosecution of this work will be attended with serious difficulties, but when accomplished, it will play a prominent part in the determination of the figure of the earth. As has been suggested, the navigation between East and West Spitzbergen is very uncertain, and even when the water is comparatively open, a change of wind may bring up such a pack of ice as to effectually bar the exit of such craft as may be behind it. Then, too, when land is reached, other obstacles are encountered in the shape of loose snow and ice. The mountains are covered with snow except where the incline is too great for the snow to lie or where the surface is so exposed to the wind as to have the snow blown off. Such places, however, are either too steep to admit of easy climbing or they are covered with loose stones, which make the conditions even less favorable. Fortunately the men in charge of the work are familiar with the difficulties that confront them, and from their experiences in Sweden and Russia, where the conditions are somewhat similar, they are prepared for the task that lies before them.

Because of its portability and the accuracy with which observations can now be made with it, the pendulum has become one of the most valuable aids in ascertaining the figure of the earth. It can be taken by parties engaged in other work, and incidentally good observations can be secured at places where a triangulation could not be prosecuted. It has been the desire of all Arctic parties to take a pendulum along and swing it in high latitudes to determine there the force of gravity, but so far the observations have not been successful, with the single exception of Sabine's work in northern Spitzbergen, latitude 79° 49'. He found for G, 983·227 dynes. The theoretical value on this parallel is 983·144, so that there is a residual of 0·083. For many years Sabine's determination was used in discussing the figure of the earth, but now that more accurate observations are available for other parts of the globe, Sabine's values are not regarded as being sufficiently harmonious to be introduced in more recent discussions.

The literature of pendulum work in the Arctic is by no means extensive, being limited to the observations of Mr. Putnam in Greenland, Schioetz in the north of Norway, and Gratzl in Spitzbergen. Of these, the last named was the most northerly, while the first may be regarded as the most accurate, if we consider the deviation from the theoretical values as obtained from the accepted formula. Last summer, through the courtesy of the Honorable the Secretary of the Treasury and upon the recommendation of the Superintendent of the United States Coast and Geodetic Survey, I was able to carry still further north one of the half-second pendulums belonging to the Survey. On the way I made a series of swings at Tromsoe, latitude 69° 36', using the pier that had been occupied by Lieut. Gratzl of the Austrian navy. Prof. Schioetz had also made observations here, but his station, situated on the crest of a sharp ridge, seemed to possess disadvantages that more than counterbalanced the single merit of a solid rock support.

I had hoped to take the pendulum to Franz Josef Land, but the reported condition of the ice to the east of Spitzbergen prompted me to attempt to reach a high latitude by keeping to the west, so I attached myself to a party of hunters bound for Ice Fjord, intending to cross over to Cape Thorsden and reoccupy Gratzl's station there in case it should not be possible to proceed further. As our boat was taking supplies for Jäderin's party, there was some chance of joining his expedition. Fortunately, the Duke of Abruzzi had just returned from a reconnoissance in the north, and the steamer he discarded for the more comfortable boat that had taken us up became available.

In two days' time, in spite of opposing drift ice, I was landed with a single companion on Danes Island, a spot now famous as the starting point of Andrée in his perilous balloon voyage. In a short time we built a small structure for the protection of the instruments and for an observing room. A most convenient pier for the pendulum was found in an outcropping rock, and the wreck of Andrée's balloon house furnished the best of material for building purposes and for fuel. By a chain of fortuitous circumstances we were brought off after several days of rather keen anxiety, and in due time reached Norway again.

While in Holland on my way home, observations were made at the observatory of Leyden, giving the second station occupied in common by our pendulum and those of European parties.

Theoretical value of G at Leyden	981·238 dynes.
Col. Defforges	981·118
Residual	0·080
Gore	981·272
Residual	—0·034

It is fervently hoped that the results of this diminutive expedition, undertaken and prosecuted as a private enterprise, may justify the labor and expense of their obtaining, and that when turned over to the United States Coast and Geodetic Survey they may prove an adequate return for the use of its valuable apparatus.

RESULTS OF ARCTIC PENDULUM OBSERVATIONS.

Place.	Lat.	Observer.	G.	Residual.
Umanak	70 40	Putnam	982·595	0·037
Tromsoe	69 36	Gratzl	982·582	—0·020
Jan Mayen	70 59	"	982·858	—0·215
Cape Thorsden	78 28	"	982·889	0·067
Tromsoe	69 40	Schiotz	982·596	—0·030
Vadsoe	70 04	"	982·631	—0·041
Hammerfest	70 40	"	982·655	—0·031
Gjaesvaer	71 06	"	982·711	—0·063
Novaja Sembla	72 22	Wilkitzki	982·714	0·003
Tromsoe	69 36	Gore	982·536	0·030
Danes Island	79 45	"	983·064	—0·035

ARE OUR WINTERS CHANGING?

By Alfred J. Henry.

The frequency and severity of the cold waves that have visited the southern portion of the United States in late years, and the fact that the last winter season began much earlier than usual, have led a number of people to make inquiry as to what are the reasonable expectations for the future? Is it probable that a more or less permanent change in the character of the winters has taken place? This problem is important, since it involves a possible readjustment of present economic conditions. It is not new, nor is it any nearer a clear and definite solution than it was fifty years ago. According to the trend of the best thought of to-day, the climate is not perceptibly changing. The mean temperatures obtained by the earliest instrumental observations, both in this country and abroad, show no differences greater than might reasonably be due to the character of the instruments used and their environment. The yearly means for a single station do not show a steady increase in heat culminating in a period of high temperature and then gradually receding toward a period of diminished heat, but rather an irregularity in the distribution of warm and cold years that suggests at once the absence of any system of compensation or any gradual progression from one extreme to the other. Studies of annual means, when broadened to include those from a number of stations scattered over the globe, are not devoid of interest, though perhaps they have not as yet yielded results of immediate practical importance.

For the States bordering the Gulf and South Atlantic coasts continuous instrumental records of the temperature previous to 1870 are lacking, although a number of broken series are available. The degree of cold experienced before that date is naturally a matter of considerable uncertainty, and while we may form a general idea of the relative severity of the winters, we are prevented from making as full an examination of the matter as its importance demands.

Taking Florida as a concrete illustration, we find that at least four very disastrous freezes have occurred within the one hundred years ending with 1898. We are inclined to the opinion that the first one, viz., that of 1835, was the most severe. The State then escaped further visitation for a period of fifty-one years, or to January, 1886. The next period of immunity was comparatively brief, viz., seven years, or to December, 1894. Within two months of the last named date, a second disastrous freeze occurred, and there have been a number of dangerously low temperatures since.

The impression that the climate is changing is partly due to the fact that in recent times an account of every severe frost and freeze that occurs in the South is sent broadcast to all parts of the country, whereas during earlier times no record was preserved except of the very severe freezes. This very lack of information respecting the earlier minor freezes prevents us in a measure from asserting in a more positive manner a rule of climate that appears to be common to all parts of the United States, viz., that periods of great refrigeration generally extend over several years. In support of this assertion, as affecting Floida, reference is made to the fact that the great freeze of 1835 was preceded by two severe winters, 1830–31 and 1831–32, and was immediately followed by a winter of more than average severity, 1836. The freeze of 1886 was preceded by a cold spell in January, 1894 (minimum at Jacksonville, 21°), and the temperature fell to 22° at Jacksonville in January of 1887. The two freezes of the winter of 1894–95 were preceded by a cold wave in 1893, in which temperature fell to 24° at Jacksonville. All of this would seem to indicate, as above stated, that cold years are likely to be followed by years of similar character separated by one or more warm years, the complete cycle of events extending over from four to seven years; but we should not forget that this conclusion is not based on sufficient data to establish it firmly.

AN EGYPTIAN GARDENER.

THE TOMB OF NEKHT. AND WHAT IT SHOWS AS TO HIS DUTIES.

IN the Manuscript Department of the British Museum are several volumes of diaries, notes, and copies of hieroglyphic inscriptions which were made early in the present century by a certain Mr. Robert Hay, of Linplum, during a residence of nearly thirteen years in the Nile Valley. From these manuscripts it appears that he spent much time at Thebes, in Upper Egypt, where he devoted nearly all his energy to the investigation of its ancient monuments. His many portfolios of beautiful drawings bear witness to the fact that he was an artist of no mean merit, but he was also a very enthusiastic antiquarian, and, like most travelers in Egypt during the first half of the present century, he beguiled his time occasionally by digging for and opening up ancient painted tombs. Among others that he discovered at Thebes was one belonging to a man named Nekht, who held under Thothmes III., and about 1500 B. C., the office of head gardener of the gardens attached to the Temple of Karnak. There are copies of some of the wall paintings in this tomb among Mr. Hay's papers, and in his diary he roughly notes the position of the tomb in relation to the neighboring buildings. Some of these buildings mentioned by Hay are still standing, and though the tomb had long since been filled up again with desert sand and debris from the rocks above, so that not a vestige appeared above ground, they served as a clew to its whereabouts when Lord Northampton, Dr. Spiegelberg, and the writer came to explore the site last winter. Within three days of beginning operations we had, with the aid of a dozen Arabs, dug down to the entrance of the tomb, and another two days sufficed to clear it.

Like most tombs of the same period at Thebes, that of the gardener Nekht is excavated in the rocky hills bordering the Valley of the Nile on the west and overlooking the great expanse of cultivated land known as the Theban Plain. A vertical cutting of the rock has been made so as to form a kind of rough façade; in the center of this has been cut a doorway with jambs and lintel bearing hieroglyphic inscriptions giving prayers for the dead. This doorway leads into a small mortuary chapel, the walls of which are elaborately painted with scenes illustrative of the life of Nekht. At the inner end and opposite the entrance to the tomb is another doorway giving access to a small chamber or shrine, in the floor of which a vertical shaft or mummy pit leads to the sarcophagus chamber in which once reposed the body of the Theban gardener.

On the left hand wall of the small chapel is a charming little painted scene representing Nekht's private house, a mud-brick, two-storied edifice, whitewashed on the outside, with a great wooden front door. To the left of the house is depicted the garden, surrounded by shady trees and with a tiny canal running down the axis of it. This little canal feeds two small ponds in which white and blue flowered water lilies flourish; it also served the purpose of bringing water into the garden for irrigating it. Two men with yokes across their shoulders and waterpots attached to them are shown diligently watering the plants. On the south side of the house is an arbor of trellis-work, over which vines have been trained. The trees which lined the garden were not feathery date palms, but full-foliaged sycamore fig trees, under whose dense growth, Nekht says, "he cooled himself during the heat of summer, and breathed the air of the sweet north wind."

A list of trees grown in the garden of one of Nekht's contemporaries has come down to us. It enumerates sweet date and dum palms, common red and green fig trees, persea and olive trees, henna, acacia, and pomegranates, as well as vines, apples, and tamarisk trees. This list is preserved on a wall of the tomb of a superintendent of the state granaries at Thebes, and beneath it is a charming little painting showing the owner of the garden in a boat on a pond, with an inscription by the side of it explaining that "he floats on his lake and cools himself under his trees while he contemplates his avenues and reckons up all the good things which he had made on the earth."

These gardens of private individuals, however, were humble in the extreme compared to the great garden at Karnak of which Nekht had charge. A plan of it has fortunately been preserved on a wall of the tomb of another Theban official. It shows that the garden was nearly square and surrounded by high embattled walls. The principal entrance faced the river, and was guarded by a porter's lodge. In the center was the vineyard, the vines being trained on trelliswork supported by brick or stone pillars. Around the garden, immediately inside the embattled walls, was an avenue of date and dum palms, and inside this again was a row of sycamores: palms were planted also on either side of the vineyard, and in the spaces between were beds for the cultivation of rare exotics and tanks for aquatic plants. A hieroglyphic inscription records that the whole was laid out in the time of Thothmes III., which makes it very probable that Nekht was the designer.

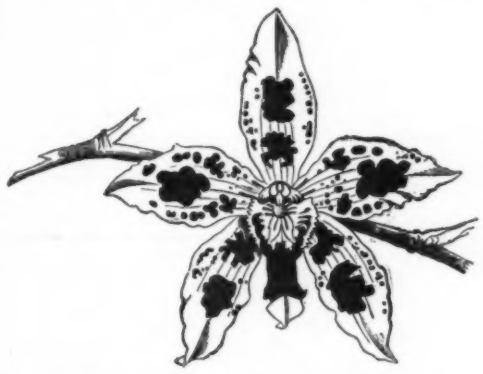
In the reign preceding Thothmes III. attempts had been made on a small scale to acclimatize foreign plants in Egypt. Thirty-one myrrh trees had been brought from the Somali country and planted in huge tubs at Der-el-Bahari. But shortly after the accession of Thothmes III. a great number of foreign plants were introduced into the Nile Valley and planted in the Karnak garden. Many of them are figured on the walls of a small chamber of the Temple of Amen, and figured so faithfully to nature that it is not difficult to identify them. There is the Florentine flag or iris, the white-flowered lilium candidum, the dranunculus, a kind of arum, the pancratium or crinum lily, a gentian, a pink, and several kinds of water lilies, and other aquatic plants. An inscription referring to these sculptured figures informs us that all these plants came from Syria. Later in the same reign, as other inscriptions at Thebes record, flowering plants and fruit trees were imported from Mesopotamia, Arabia, the Somali country, and even the Greek islands. The Egyptian, in fact, seems to have spared no pains to grace his garden with all the profusion and variety which cultivation could obtain. They were particularly fond of sweet scented flowers, a fact worthy of notice, for it proves that, unlike the Jews and early Greeks, they were at an early period keenly alive to the sweet odor of flowers. Mr. Gladstone long ago pointed out that Homer often speaks of flowers as "tender," "white," "hyacinthine," but never as "sweet smelling."

Nekht's duty was not merely to cultivate plants; he had also to supply his king and the priests with cut flowers and fruits for the decoration of the temple on all the principal festivals. Officially he bore the title of "purveyor of cut flowers for the god Amen." Doubtless also he supplied many of the Theban damsels with those flowers they were so fond of using for the decoration of their hair. Great quantities of cut flowers were used for embellishing the houses of the wealthy, and a blossom of some kind was nearly always presented to a guest at a banquet, just as at the present day we are given our "buttonhole" at a house party—a pretty custom, and an ancient one. In his tomb Nekht is depicted presenting Thothmes III. with a huge bouquet, five feet high, and composed of papyrus, lotus flowers, cornflowers, and poppies, interspersed here and there with fragrant fruits of the mimusopsi, a tree not now found in the gardens of Egypt, but well known at the present day in India. Some of these garlands have been found in the ancient cemeteries of Egypt, buried with the dead.—Percy E. Newberry in The London Post.

ODONTOGLOSSUM × CORADINEI, WEST BANK HOUSE VAR.

As with most Odontoglossums, so in the representatives of this natural hybrid between O. Lindleyanum and O. crispum, there is much variation. The ordinary forms with their narrow pale yellow segments, bearing a few brown blotches, being esteemed only superior to O. Lindleyanum; while the remarkable varieties, which are, however, very scarce, are fit to rank with O. triumphans and others of the showier section. In both good and bad forms, the long straight column, followed for the greater portion of its length by the basal part of the labellum, is a characteristic showing the affinity to O. Lindleyanum. The features of the indifferent varieties are distinctly those of O. Lindleyanum modified by O. crispum, while the good forms in their broader ovate-lanceolate outline show C. crispum, changed and colored by the influence of O. Lindleyanum. Therefore we may conclude that the cross has been effected both ways.

The sepal and petals are ovate-lanceolate, and nearly equal in width. The ground color is lemon yellow, changing to nearly white toward the base. The sepals each bear in the middle one large chestnut-red blotch,



ODONTOGLOSSUM CORADINEI—WEST BANK HOUSE VARIETY.

about ½ inch in length, and one smaller blotch toward the base, the margin having a chain of small red-brown dots. The petals have the large chestnut-red blotch on the outer half, the lower parts and margin bearing clusters of small red-brown spots. The tip of each segment is bright yellow. The lip, which is showier than the ordinary varieties, though of the usual form, has the blade, except the apex, chestnut-red, the base cream-white with red lines.—The Gardeners' Chronicle.

MICROBES IN CO-OPERATION.

By G. CLARKE NUTTALL, B.Sc.

OF late years botanists have been made very familiar with that kind of relationship shown to exist in certain instances in the plant world which is known as Symbiosis. In these instances we find two organisms living a common life of mutual benefit, each supplying the other with some requisite of its existence, and receiving in return some essential to its own well-being. The arrangement does not necessarily benefit both sides equally, and never is the advantage of the same nature on either hand; the essential point is that there is a common life of two organisms with a mutual advantage of some kind or other. A lichen is, perhaps, the best and most striking illustration of a symbiotic union, where a minute rudimentary green plant—an alga—and a fungus, living and growing in intimate connection, give rise to that product which we term a lichen thallus. In this case the mutual benefit lies in the fact that the alga provides food for the fungus and the fungus stimulates and shelters the alga.

Metabiosis—we owe the name to the French chemist Garré—is another kind of relationship existing in certain cases which is of later recognition and not so generally known at present. For one thing, all the instances yet found of this condition are confined to the world of the bacteria, and hence do not furnish so obvious or so familiar examples as the lichens do of symbiosis; moreover, there is lacking in metabiosis that suggestion of sensationalism which caused so much interest and controversy when the double nature of the lichen household was first put forward for acceptance. Nevertheless, metabiosis, as a condition of life, has, for an interested observer, a fascination peculiarly its own.

Now, metabiosis may be broadly defined as that relationship which exists between two organisms when for one of the two to flourish and live in a certain medium it is necessary that the other should have preceded it and prepared the way for it. The development of the one with its consequent reaction on the environment is a necessary condition of the development of the other. The first is independent of the second and in no way touches it in any intimate way; the second is wholly dependent upon the good offices of the first, for without its predecessor had lived and developed and through its living changed the character of its environment, it could never have been called into active life.

An example will perhaps best serve to illustrate the point. It was found some time ago that certain of the very finest wines produced in the vineyards of the Rhineland were made from grapes that, after they had been gathered, were allowed to stand and go mouldy and "bad," and apparently become absolutely useless and disagreeable. Yet it was from these very grapes that the wines possessing the best flavor resulted. Now, a clever German chemist, Müller Thergau, examined the matter from a scientific point of view, and he found that the mouldiness which appeared on the grapes after standing was a fungus which lived on the contents of the grapes, and which in absorbing its food changed the chemical constitution of those contents, so that when the fermentation process began through the agency of yeast organisms, they were favored and affected for the better by the changes which had already been brought about by the mould fungus. Here then the yeast stands in a metabiotic relationship to the mould fungus. The mould is absolutely independent of the yeast and appears under any circumstances; the yeast organism can only take that particular line of development, with the resulting production of "bouquet," when the way has been prepared for it by the mould fungus. It is dependent upon its predecessor for its particular action—that is to say, we have here a condition of metabiosis.

Prof. Lafar gives an instance of a whole series of metabiotic relationships when he explains, with much lucidity, the sequence of events in the evolution of wine from the grape.

The skin of the grape, he says, is naturally the home of many varieties of fungi, especially bacteria, and when the grapes are gathered and pressed down; these germs are naturally also to be found in the "must." And since the germs are of many varieties, they, of necessity, differ as to the conditions most favorable to their development and as to the length of time they demand for the various stages in their life processes.

The first to develop are the yeasts—the organisms which bring about ordinary alcoholic fermentation. These seize upon the sugar of the grape for food and split it up into carbon dioxide and alcohol, and thus at once the original constitution of the "must" is greatly altered. Another species of germs, hitherto lying dormant, then spring into activity, as the conditions are now those which most favor its development. These are the organisms which bring about acetic fermentation, for their food is the alcohol which the yeast brought into existence, and they, in acting upon it, oxidize it by means of the free oxygen in the air, and thus produce acetic acid. It is obvious that the relation between the two species is here again one of metabiosis; the bacteria producing acetic acid could not have developed in the "must" as it was in its earliest form, for no alcohol was then to be found in it; the germs might be abundantly present in the liquid, but their growth was wholly dependent on the yeast preceding them and preparing the way for them. Thus they are under an absolute obligation to the yeast, though the yeast is entirely independent of them. The result of this second stage in the proceedings is therefore a strongly acid liquid.

But now a third kind of bacteria come into play, which themselves stand in a metabiotic relationship to the second. An acid liquid is their natural home, and as the originally sweet "must" has become distinctly acidified, the dormant germs of this species are aroused into activity. They seize upon the acetic acid present, and under their influence it rapidly becomes split up into carbon dioxide and water. The bacteria accomplishing this are the thread fungi (the vinegar eel is one of the members of this variety), who thus form a third link in the metabolic chain, and their special work is the elimination of the acid.

And the thread fungi are themselves the forerunners of yet another new-comer. Certain Schizomycetes—bacteria which promote putrefaction—had entered the "must" with the dust and air in the first instance, but had had no chance of growth until this late stage, for alcohol is poison to them and acetic acid distinctly injurious. So while the yeasts were producing alcohol and the second species was replacing it with acetic acid, they were compelled to remain quiescent, and it was not until the alcohol had been removed by the bacteria promoting acetic fermentation, and the acetic acid had in its turn been reduced by the thread fungi, that the way was clear for their appearance.

The above sequence of changes thus gives us several instances of metabiotic relationship, and indeed it is probable that in most cases of fermentation and putrefaction we have much the same sort of thing happening; in all cases, that is, where several varieties of bacteria have their habitat in the same medium.

It is difficult to over-estimate the practical value which a full recognition of the possibilities and limitations of metabiosis may have. At present we can scarcely claim to do more than stand on the threshold of the new study. Up to now the aim of the bacteriologist has been chiefly to isolate single kinds of bacteria, and by cultivating them in a pure state to study each species by itself, ascertaining its exact nature and its power of work; but in the future he will find this is only the preliminary to the more complicated study of combination, and he will have his most fascinating work in combining, adding, and subtracting, in endless variation, different species of bacteria in the same medium, and thus get an infinite number of independent results. Here is a simple example of a combination that has been artificially brought about.

A certain bacterium has been found to have the power of fermenting starch into glucose, and a certain yeast, it has been ascertained, can change glucose into alcohol. Now, by putting together pure cultures of this particular bacterium and of this particular yeast into starch, alcohol can be obtained as a result of their joint efforts. This simple illustration of the power of combination merely points the way to others of greater import which may be arranged in the future, and, in fact, in judicious blending and combining probably

lies the greatest development of bacteriology in the near future.

The ripening of the curd in cheesemaking is now shown to be the work of bacteria whose home is in the milk, and this is proved by the fact that if the milk is sterilized prior to cheesemaking, no proper cheese can be produced, as the curd never ripens. But no single bacterium is responsible for the whole result, rather several species are involved, each contributing part, and part only, of the whole work, and living almost certainly in metabiotic relationships. For example, in certain investigations made by Dr. Weigmann in this matter, he found in several instances that two different forms of bacteria were present, and that a characteristic smell and taste accompanied their development; but when these two forms of bacteria were isolated and cultivated separately, neither was able alone to give the specific taste and smell, and not until the companionship was restored was the original result attained.

So, too, in buttermaking. It is bacteria again who are responsible for turning the cream sour and who bring about the changes in its constitution which give aroma and flavor to the butter. Dr. Weigmann, in his observations at Kiel, discovered that no culture of single species alone could give a good taste with stability, when introduced into cream. Perfection of flavor with "keeping" properties were invariably the result of a blending together of several forms of these germs, and that if artifical souring was to be successful, a knowledge of judicious blending was absolutely necessary. This implies nothing more nor less than metabiotic relationships between the different kinds of the bacteria concerned. These instances are sufficient to indicate, at any rate, the vital importance of metabiosis in our study of the lives and works of the innumerable species of bacteria, and the great stress that must be laid on a right comprehension of this relationship in all future considerations in this direction.—Knowledge.

A NEW AUTOMOBILE FIRE ENGINE.

WE illustrate herewith, from La Nature, a new automobile fire engine invented by M. Porteu, and manufactured by M. Cambier, of Lille.

The frame, which is of U-shaped bar iron, supports both the motor and the pump.

The motor, which is a gasoline one, and is placed in the rear, consists of four explosion cylinders, *C* (Figs. 1 and 2), in pairs, placed symmetrically with respect to the longitudinal axis of the vehicle. It is of 22 horse power. The ignition is electric, and the carbureting is effected by the Longuemare apparatus.

The rods of the four pistons are assembled in two pairs upon two cranks and communicate motion to the shaft, *A*, which is provided with flywheels, *V V*, at its extremities. This shaft, through a train of gear wheels, transmits motion to an intermediate transverse shaft, *A'*, which might be called the distributer of motion, since it actuates either the propelling apparatus or the pump, as may be desired. It communicates motion to the vehicle through the intermedium of drums, *M N O*, the different diameters of which furnish two running speeds that correspond to about nine and five miles an hour. These drums actuate a series of fixed pulleys, *b d*, and idle pulleys, *b' d'*, keyed upon the shaft that carries the chain sprockets, *p p*.

Transmission from the drums to the pulleys is effected by cross belts, the shifting of which from the fast to the idle pulleys is produced through the action of the rods, *h h*, which are maneuvered from the front of the vehicle by a lever, *L*, mounted upon the same axis as the steering wheel, *V*.

The intermediate pulleys, *N* and *e*, belong to the mechanism that produces a backward motion, and are connected by a belt upon which acts a stretcher, *T*, maneuvered through a handwheel, *V'*, placed under the front seat. All the belts are surrounded by an iron plate jacket that protects them from the action of the water coming from the pump.

The pump is actuated by the shaft, *A'*, which communicates motion to the driving wheel, *M*, through a pinion keyed upon the shaft.

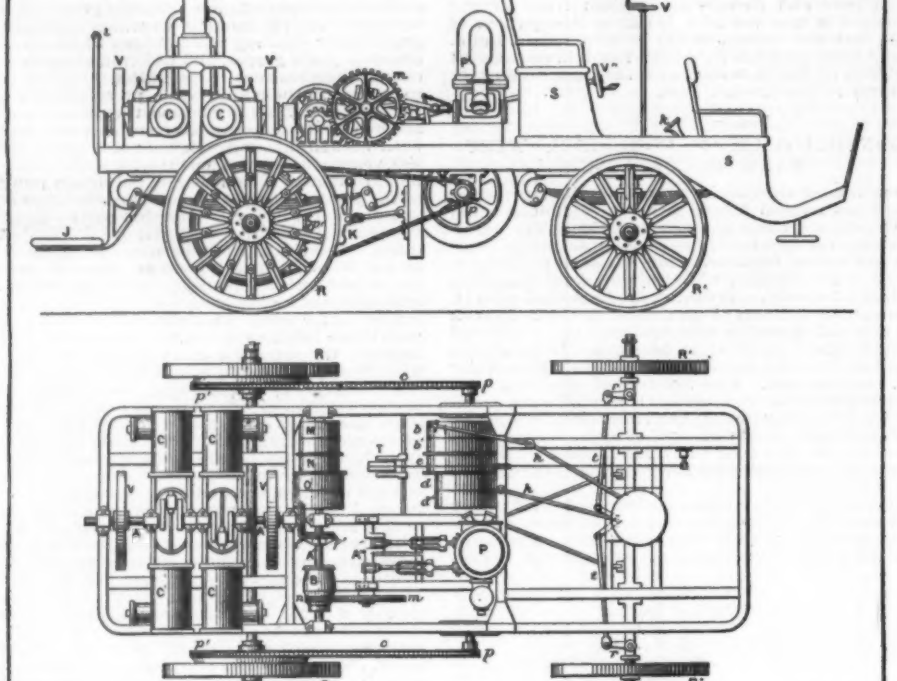
The throwing of the drums into gear and of the pump out of gear is effected instantaneously and automatically. A fire may thus be attacked as soon as the engine arrives upon the spot, without its being necessary to modify the running of the motor in any way whatever.

The pump, which is of the Thirion system, is capable of throwing 3,000 gallons of water a minute. Power is transmitted to it wholly by gearings, so that the inconveniences that would result from the use of belts, through the stretching of the leather under the action of the water coming from the pump, are done away with.

The steering of the engine while running is done by means of the handwheel, *V*, which acts upon the pivots of the front wheels, *R' R*, through the intermedium of rods, *t*, and levers, *r*. Finally, the vehicle is provided with a brake, *K*, which is actuated by a pedal, *B*, placed under the foot of the driver.

As such an apparatus must carry a number of firemen with it, the fore-carriage is provided with two seats, *s* and *s'*, each capable of accommodating three persons, and with a platform, *J*, in the rear, upon which several men can stand.

This new engine has been submitted to numerous experiments in the presence of the chief of the Paris Fire Department and his staff, and of many other persons competent to judge in such matters, and has been found to operate in the most satisfactory manner.



FIGS. 1 AND 2.—SECTION AND PLAN OF THE PORTEU AUTOMOBILE FIRE ENGINE.

PHYSICAL MEASUREMENTS IN ANTHROPOLOGY.

THE question of the value of physical measurements is one that lies at the base of physical anthropology. Large numbers of often very extended series of measurements are continually being published, new methods are constantly being proposed and tried; but in spite of all this, it is questionable whether the value of the results obtained is proportionate to the trouble expended. Unfortunately, there is variability in the methods employed, which may change according to the nationality of those of the investigators; some methods are complicated, like Benedikt and Toerok, or, as in the case of the latter anthropologist, who takes 5,000 measurements on a single skull, they may be impracticably numerous. Very precise measurement with refined instruments gives an apparent exactitude which appears to be more scientific than it really is. Preferable is the system that adopts a small number of measurements which can be readily made, and which have a better chance of being taken on a large number of subjects.

The extreme exactitude of cranial measurements, especially when based, for example, on the cephalic index only, has often led to creating imaginary races among a given people.

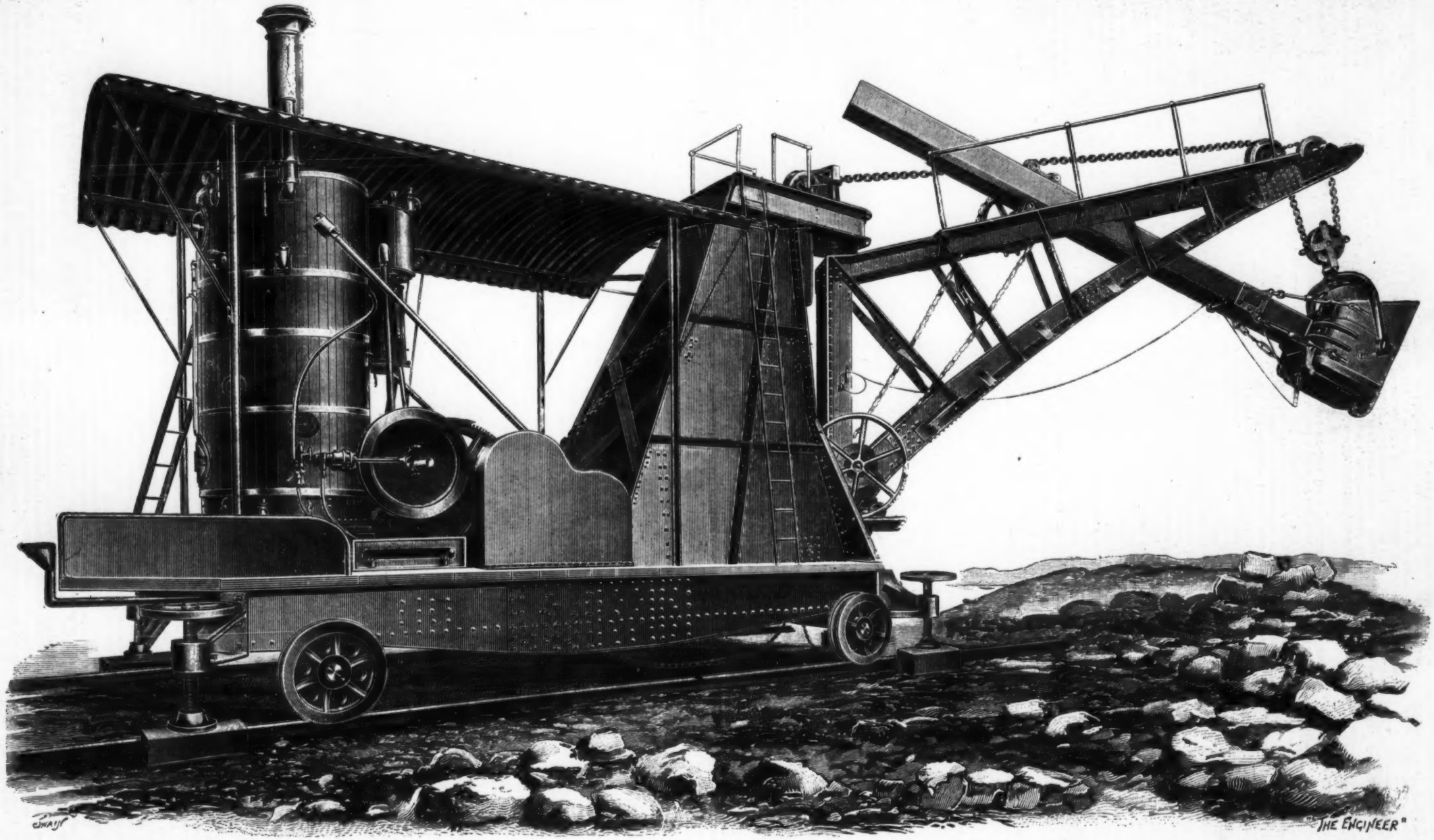
These and other wholesome warnings are uttered by O. Hovorka Edler von Zderas in the Centralblatt für Anthropologie, iii. p. 289, who also points out that there is no need to calculate indices to the first or second decimal, and he also states that in the analysis of a people one should not take account of differences of less than ten units in the index.

As all investigators are well aware, the cephalic index gives no information upon the real form of the skull; this has been well emphasized by Sergi, who has sought to establish a more rational system of skull nomenclature. M. L. Laloy supports (l'Anthropologie, x. p. 105) Hovorka's general contention, and refers to the clever visual analysis of the inhabitants of Bretagne by Dr. P. Topinard, which was published in the Journal of the Anthropological Institute (1897, xxviii. p. 99). In the last number of the Journal (new series, i. p. 329) Dr. Topinard gives the results of the trip which he made to Cornwall last year in order to compare the anthropological types there with those he had previously ascertained in Bretagne.

But in our own country Dr. J. Beddoe has long adopted a similar method of investigation, and his acute and trained powers of observation have thrown a flood of light on the problems of the races of Britain. The methods of the doyen of British anthropologists are those of the field naturalist, and there are many who realize that what is generally known as "natural history" is as integral a part of biology as is the most refined laboratory technique. It is well to use one's eyes for other purposes than for reading off scales on instruments.—Nature.

FIG. 3.—THE ENGINE IN OPERATION.

FIG. 4.—THE ENGINE IN RUNNING ORDER.



TEN-TON STEAM NAVVY.

STEAM NAVVY.

A TEN-TON steam navvy of a type similar to those used in the cutting of the Manchester Ship Canal, where no less than fifty-eight were employed, is illustrated herewith. It was constructed by Messrs. Ruston, Proctor & Company, Limited, Lincoln, to whom we are indebted for the following particulars, says Engineer. The construction of the machine and its method of working will be gathered from the illustration. The bucket on the end of the arm is pulled in and up by the chain and tackle wound in by the steam-driven winch. The material is dropped from the bucket into the wagon run up on rails beside the navvy by releasing a trigger which allows the bottom to fall open. The machine, it will be seen, is very powerfully made. It weighs about 36 tons, but for convenience of export and repair no part in it exceeds over 11 cwt. The gage for its wheels when working is 10 feet 6 inches, but for transport over railway lines it has also a narrow gage of 4 feet 8½ inches. Working under favorable conditions but in hard material, it will shift and fill into wagons from 800 to 1,000 cubic yards per day, at a cost of from 60s. to 70s. with coal at 20s. per ton. For its working there are required eleven men and two horses. When large four-yard wagons are used in connection with it, a 2¼-yard bucket gives the best results; but, though at a slower rate of working and increased cost, a smaller bucket, 1¾ yards, can be used when large trucks are not available. The greatest amount of excavation at the least cost is secured when working one road with a short jump, using large buckets and wagons. The coal consumed under these conditions should be about 10 cwt., and the value of oil and waste used about 3s.

The machine works at its best under these conditions and with a face not less than 10 feet, and a face up to 20 feet is better. Where a higher cutting, say 30 feet, has to be attacked it is cut in two stages of 15 feet each. The excavator is self-propelling.—The Engineer.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Brick Factory in Mexico.—The brick manufactory of Monterey, Mexico, was established in 1891 with a capital of $250,000 Mexican (in 1891 the Mexican dollar was valued at about 75 cents in United States currency), and has a concession from the government exempting it from taxes for the period of twenty years, says Consul-General John K. Pollard, of Monterey. During the last three years the company has shipped 6,500,000 brick, principally for the construction of sewers at San Antonio, Texas, and at present it is shipping 1,000,000 monthly to Mexico city for similar purposes. The annual output is about 24,000,000. There are 40,000 dry-pressed brick and 40,000 wet brick made daily, the wet being placed in drying sheds in piles for five or ten days and then in the oven or kiln.

There are one hundred and fifty men employed and five or six boys all told, the wages paid ranging from 62 cents to $3 Mexican (29·8 to 96·2 cents) per day. Machinists receive $150 ($72.15) per month, and the foreman $130 Mexican ($62.58). The superintendent receives $150 ($72.15), as does also the burner (man who attends the kiln).

The wet brick are used in paving the streets, setting boilers, etc., and the dry for building purposes. There are nine kilns, six having a capacity of 280,000 and three a capacity of 400,000 brick. From twenty-five to thirty days are consumed in burning a kiln after the brick have been placed therein.

Dry press, mud brick, standard and fancy shapes, tiling for paving and roofing, are among the products of this enterprise. The plant is situated on the main line of the Monterey Mineral and Terminal Railroad, facilitating the loading of brick into cars.

The machinery comprises one Ross Keller, six mould dry press machines, with a capacity of 40,000 brick daily, and two Pendleton mud brick machines with a capacity of 40,000 brick daily.

Owing to the large increase in the demand for their product, the company has installed an electric light plant, and the works run day and night, which will increase the output considerably.

The clay from which the brick are made is of a very fine quality, and is of a deep crimson color after being burnt. There is enough clay in sight to supply the plant for a period of twenty-five or thirty years or longer. It is conveyed to the machines by means of a mule tramway and cable, thirty mules being used for this purpose.

There is quite an extensive commissary at the plant, where the workmen can buy all their supplies at current market rates; there are also houses for them to live in. The officers of the company are J. A. Robertson, president; J. H. Robertson, vice-president and general manager; T. A. Robertson, secretary and treasurer; and L. J. Heder, assistant manager and superintendent—all Americans.

Locomotives in Germany.—Germany has eighteen factories turning out locomotives, both for home and foreign use, says Consul J. C. Monaghan, of Chemnitz. Fifteen of these build both large and small engines, and three build nothing but small ones for light work. These factories can furnish annually, under normal conditions, 1,400 engines. They employ from 15,000 to 20,000 workmen—the number depending upon the orders. Germany exports locomotives to Russia, Sweden, Norway, Denmark, Turkey, South America, South Africa, and Asia. A house here sent nineteen a year or two ago to the Dutch East Indies.

Up to date, as far as can be found out, no United States engine has entered this empire, although England has ordered a number. A writer, whom I quote freely, says that work can be more effectively done in the United States, because only a few well-tried forms of engines are made. "In consequence of this," he continues, "the parts are put up and kept in supplies by all parties acting as agents of such engine builders. This enables those buying American engines to replace broken or injured parts almost instantly." German writers say the firms in Europe could do the same in the time put down for delivery, etc., were it not for the fact that every railroad company, every engineer, wants a particular type. They go so far as to express preferences for different kinds of different parts, and every change of officials or engineers having charge of the purchase of locomotives or their parts brings change in the articles used. Consequently, Germany has found it impossible to keep a supply of parts. "This," says the writer referred to, "may keep Germans from overproduction, etc., but it has the disadvantage of delaying deliveries. An understanding among the builders of locomotives might lead to a system not only advantageous to the empire, but useful to the exporters of locomotives. It would help to keep territory already captured in far-off lands and fit Germany to meet America's rapidly rising influence."

It is hardly necessary to say that American locomotive builders will do well to look these lines over. They have never had such a chance as now. All Asia, Africa, Australia, North and South America, many states of Europe, particularly Russia, offer markets which we are the only people fully equipped to supply.

Trade Suggestions for Asiatic Turkey.—Consul Washington sends from Alexandretta, under date of June 2, 1899, copy of a report by the British consular representative at Erzerum, containing suggestions for increasing the trade of his country with Asiatic Turkey. Mr. Washington thinks that the information may be of value to United States exporters, as showing the kind of competition they are likely to encounter. The report reads, in part:

"Trade catalogues and price lists, edited to suit the different localities of this country, with comparative measures and prices in both languages, would be valuable. At present, English catalogues reach me with no comparative price list in the currency of this country, and of manufactures utterly unsuited to this district. Recently, a catalogue of bicycles came to hand, none much cheaper than £20 ($97.33) apiece. This betrays ignorance or carelessness. No bicycles can be used here, where a decent road is unknown, in a mountainous district varying from 5,000 to 10,000 feet high. Even if they could be utilized, no one could afford to pay more than £2 or £3 ($9.73 to $14.60) for a machine.

"The distribution of catalogues should vary according to the very different requirements of each district of Asia Minor. Thus, goods for Adana would be useless in Erzerum.

"For the above reasons, I would advocate the establishment, by interested British merchants and manufacturers, of a central office in Constantinople for the collation and distribution of catalogues and other information, as a center of reference for native merchants to ascertain comparative weights, measures, and prices, and to communicate the wants of this country to manufacturers at home. Such an agency might also serve as a general commission house for the transaction of considerable business now passing to Germany and Austria. The fact that almost all merchants in the provinces obtain their goods from middlemen in the capital points to the advantage of what I here advocate. It would be of much benefit to British commerce in Asiatic Turkey, where each district has its own particular rate at which gold payments are accepted. Thus, at Adana this rate is 136 piasters to the English £1. In Erzerum, it is 109 or 110 piasters. At Constantinople it is, I believe, 118 piasters, and so on. How is it, then, possible to compile comparative price lists in England? At Adana, a tropical summer heat prevails for seven months, while at Erzerum the thermometer registers a general winter temperature of some 40° of cold. Yet at both places I have received identical catalogues of goods totally unsuitable for the one or the other locality. Again, the advocated agency would, in my opinion, turn into British channels many orders now going elsewhere. Many merchants are deterred from direct dealings with England through ignorance of the necessary methods for establishing such a trade. They are driven for their orders to unscrupulous Greek or Armenian middlemen in Constantinople, who palm off on them the cheap wares of other countries, the prices of which enable them to make a higher profit than on our more expensive, but better, goods.

"I hesitate to advocate, at Constantinople, anything so extended as the formation of an amalgamated company of British manufacturers or merchants. I cannot think that this is practical or necessary. It is not to be expected that our merchants would risk their capital in such an enterprise without having first some fair guaranty of remuneration. Nor would I establish at such a center a general corps of commercial travelers. I am persuaded that such an understanding would not pay, with the difficulty of regulating fairly the share of business interests of each firm; of controlling unprincipled individuals who might use unfair means to stimulate their own concern through undue remuneration to the traveling agents, or other means. Thus, one might offer 5 per cent., another 10 per cent. remuneration on all undertakings. In the East especially such a scheme is impracticable. The plan which I propose is something far simpler. It is nothing more than a reference agency, at very small cost, open to every branch of trade, at which all classes of business can be done at a fixed rate, such as the compilation of catalogues, comparative price lists, the distribution of suitable catalogues in different districts, the drafting of letters in the vernacular of the country, replying to all questions, and many other useful matters. If a certain number of British firms would join in starting such an enterprise, a guaranteed sum of from £1,800 to £2,000 a year would probably be sufficient to maintain it, the private work of individual firms going afterward to defray extra expense incurred in fulfilling the objects of the agency already set forth. The agency would also be found useful for the collection of bad debts.

"If our mercantile classes will not give themselves the little trouble entailed by this proposal in order to endeavor to develop and recover our trade at such small monetary risk, the fault will lie with themselves alone if commerce slips more and more through their fingers into the hands of foreign traders. In my own district alone, I could put such an agency in the way of bringing much small trade to England, such as paper, cloth, fezzes, fancy goods, and many others, which now goes elsewhere owing to the impossibility of explaining the necessities of this country to merchants totally unacquainted with its peculiarities. This is the chief reason why so much trade in smaller articles now goes to foreigners, who, not content with supplying the Greek and Armenian middleman, have established the means of directly studying and satisfying the wants of the local merchant. Most foreign houses, besides, have a traveling partner in their business, with a good linguistic knowledge, who travels in order to pick up useful hints independently of the information which comes from their agents. It is by such means, alone, that we can hope to retain our trade in these days of increasing competition."

American Barber Chairs in Germany.—More American barber chairs should find their way into Germany. In the large cities, shops of the first class possess many chairs of American make, says Consular Agent Ernest L. Harris, of Eibenstock. In the provincial towns, a comfortable barber chair is rarely seen. The ordinary chair in Germany has a cane bottom with a wooden head rest. In Germany, barbers shave customers to a certain extent in their own homes. Much time is spent each day in going from house to house. I think one reason may be the poor equipment of the shops. The best way to introduce these chairs is for our manufacturers to secure membership in some one of our export associations which have established sample rooms in the large cities of Germany. The chairs should be put on exhibit, and I am sure some middleman would soon be found who would undertake the task of introducing them into the smaller towns and villages. I might further add that a few months' credit would greatly facilitate sales. Other barber supplies, such as razors, soaps, perfumed waters, mugs, brushes, etc., would, in my opinion, find a smaller market, as these articles are exported more or less from Germany to other countries.

Sugar in Spain.—Mr. Mertens, in charge of the consular agency at Valencia, under date of June 5, 1899, says:

Since the loss of her colonies, Spain's sugar factories, with a yearly production of about 60,000 tons, are unable to satisfy the public demand, which amounts in all Spain to about 100,000 tons of sugar during the year. A high prohibitive duty of 102¼ per cent. on foreign sugar protects the home industry and stands in the way of sugar dealers and consumers. For this reason a union of tradespeople and merchants of the different cities of Spain has petitioned the Spanish government to reduce the import duty to 50 per cent., which would afford a fair protection for the refineries and at the same time permit the import of sufficient sugar to supply the demand. While this petition meets with great opposition from the refiners, still, in view of the need of sugar and the small chance of increasing either the number of factories or their output in the near future, the Spanish government will probably reduce the duty, more especially as this will add to the customs income of the country and do away with the incentive for smuggling. As soon as this reduction becomes a law, our dealers in refined sugar should be ready with samples to secure contracts, before the competition with other countries becomes too keen.

Demand for Shipping in British Columbia.—Consul Dudley sends an undated report from Vancouver (acknowledged by the Department June 17, 1899) as follows:

I have for several months observed the fact that very few sailing vessels are coming to this port to load lumber for China, Japan, Australia, South America, and South Africa. When I first assumed charge of this consulate, there were a number of such vessels engaged in this traffic. Many boats are needed here and would be chartered immediately if they could be obtained, as the shippers of lumber find it impossible to secure them. The increase in exports of lumber from Washington and Oregon in part accounts for the change. The large wheat crop of last year and the immense foreign demand has also taken up much of the shipping formerly engaged in the lumber traffic, the owners of vessels preferring to carry grain rather than lumber. If there are sailing vessels on the Atlantic coast seeking employment, I feel very certain they could obtain it by coming to this coast. The export of coal from Vancouver Island is steadily increasing, and sailing vessels find employment there, although the largest quantity of coal is carried by steamships. Owners of vessels can secure full information by addressing any of the shipping firms at this port, at Seattle, Wash., or at San Francisco, Cal.

Water Filters for China.—Under date of Chefoo, April 22, 1899, Consul Fowler writes as follows:

When in Port Arthur last November, I noticed the soldiers drinking out of large jars, or kongs, water which was unfiltered and certainly dangerous. It occurred to me that if American manufacturers could sell a good cheap filter, or, better still, small condensers for condensing either fresh or salt water, an immense market would be opened to them, not only among the Russian troops, but among the British at Weihaiwei and the Germans at Kyao-chau, not to mention foreigners and even Chinese elsewhere in this empire, who now depend upon muddy river or rain water for all purposes.

Hawaiian Representation at the Omaha Exposition.—The Department has received from Consul-General Haywood, of Honolulu, under date of May 26, 1899, a copy of a report to the chamber of commerce, recommending that an exhibit of the products of the islands be made at the exposition to be held at Omaha. The exhibit will comprise native fruits and plants, coffee, rice, sugar, etc.; photographs, antiquities, woods, shells, curios, etc.; also a display of the educational institutions of the country, including the handiwork done by seminary girls.

Russian Oil in the Azores.—Consul Pickerell, of St. Michael's, under date of June 8, 1899, reports the arrival of two consignments of Russian illuminating oil, being in all 700 cases of 65 pounds each and 125° test. This oil, Mr. Pickerell understands, is shipped by J. H. Andressen, of Oporto and Lisbon, and consigned to Clemente Jacintho de Costa. He adds:

There is evidently a desire to force the sale, as Mr. de Costa says that the price is higher than American. His complaint has been met by the answer to go ahead and sell it, as he would be protected in all loss. The oil can is stamped Batum.

Invoices for Turkey.—Consul Bergholz, of Erzerum, under date of June 2, 1899, says: An Armenian merchant here, Missak Venetzian, who has recently been ordering goods from the United States, complains that certain shipping agents in New York have added to the cost of his goods by having an invoice sworn to before a notary public and his signature and seal authenticated by the Turkish consul-general. I would ask the department to notify exporters that consular invoices are not required by the Turkish customs authorities.

Proposed American Bank in Caracas.—Under date of May 5, 1899, Consul Plumacher writes from Maracaibo in regard to the establishment of a bank at Caracas by United States citizens, represented by Mr. George W. Upton. In a communication to Consul Plumacher, Mr. Upton says that the capital of the bank is to be 15,000,000 bolivars ($2,895,000); it is to be installed within four months and the charter will last fifty years. The government has been petitioned to grant free introduction of the furniture and materials necessary for the construction of the buildings. Mr. Plumacher adds that such an enterprise in Maracaibo would be remunerative and would facilitate United States trade.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 478. July 17.—Prosperity of British Colonies—*Crops in Russia—*Suggestions for Exporters in Germany—*Furniture in Germany—*New Mail Service with the Azores—*Russian Oil in the Azores.

No. 479. July 18.—American Fruit in the Netherlands—Public Ways and Parks in Silesia—*Agriculture in Mexico—*Brick Factory in Mexico—*Proposed American Bank in Caracas—*United States Trade with Mauritius—*Dominican Duties Payable in Gold.

No. 480. July 19.—Tariff of Jamaica: Effect upon Trade.

No. 481. July 20.—Imports of Paraguay—*Assay Offices in British Columbia—*Railway Concessions in Mexico.

No. 482. July 21.—The India-Rubber Trade—*Trade Suggestions for Asiatic Turkey—*Dried Fruit in Germany—*Match Monopoly in Colombia—*Spanish Tariff on Flour.

No. 483. July 22.—*Resources and Trade Opportunities of the Amazon Valley—Railroad Ties Forgotten in Brazil.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

MISCELLANEOUS NOTES.

The Boston and Maine Railroad has been burning coke in the engines of the Gloucester branch in the place of coal. It is expected that it will be but a short time before all their lines use coke.

The striking mechanism of "Big Ben" on the tower of the Houses of Parliament, London, is a ponderous affair. The well which is provided for the weight which drives the machinery is 174 feet deep, and the weight itself weighs a ton and a half. It requires to be wound only once in four days. The hammer is a very heavy affair, in order to fetch the full tone out of the bell, weighing fifteen or sixteen tons. The machinery works with such precision that the Astronomer Royal says that the bell does not vary a second in striking all the year around.

The government authorities at Washington have decided to limit the competition for the designs of the proposed memorial bridge across the Potomac at that city to four prominent bridge engineers. Under the arrangement the competing engineers will be paid $1,200, $1,100, $1,000, and $900 respectively for their services. The appropriation available for obtaining plans for the bridge is $5,000. Originally it had been intended to invite plans and designs from fifteen engineers, but owing to the great cost involved in the preparation of the plans it was decided to change to the present arrangement. The names of the four engineers selected were published in the last number of the SCIENTIFIC AMERICAN.

When figuring upon the installation of an electric transmission plant it is necessary to allow a sufficient factor for losses. An authority gives these as follows: Loss due to friction of steam engine, 10 per cent.; loss in belting between engine and generator, 3 per cent. if direct connected this is not figured; loss in generator, 10 per cent; loss in line, 10 per cent. to 20 per cent. depending on its length, size of conductor, care in building line, etc.; loss in motors, 12 per cent. to 20 per cent. depending on kind used and service required of them; 5 per cent. to 10 per cent. loss between the brake horse power and the machine to be driven, to which may be added the loss in the machine itself due to friction. Total efficiency, 50 per cent. taking the lowest estimate of loss. Where the distance is short and great care is taken in making the installation the actual efficiency may be increased to 60 per cent.

A strange story is in circulation, to the effect that the Chinese government is about making a contract for pulling down the famous Chinese wall, separating China proper from Tartary. The wall is about 1,300 miles long, and from 20 to 25 feet high, and of enormous thickness. The facings are all of hewn stone, and there are several thousand towers for the garrison which defended it. On the principle that it costs about half as much to pull down masonry as it does to put it up, the expense of taking down the wall, even with cheap labor, would hardly be less than five thousand million dollars, and it is impossible to conceive what benefit would be derived from the process. It is said that some of the materials are to be used for new constructions, and it is quite possible that a few thousand yards of cut stone might be taken from certain portions of it, and utilized in the neighborhood; but anything like a complete removal of the wall is, fortunately for the Chinese archæologists, very unlikely to be undertaken.—American Architect. [The figures of cost of removing the masonry are doubtless exaggerated, still, it would probably cost a great many hundred million dollars.]

A. d'Arsonval communicates some important observations concerning the action of the various gases upon caoutchouc and upon rubber tires. If bits of caoutchouc tubing are placed in gaseous carbonic acid, under a pressure varying from 1 to 50 atmospheres, the substance increases considerably in volume and absorbs large quantities of the gas, so much so, that it often acquires 10 or 12 times its original volume. At the same time, the caoutchouc becomes more gelatinous and less elastic. On leaving it exposed to the air, the carbonic acid disengages itself in bubbles, making a crisp sound on leaving, and in about an hour's time the caoutchouc has resumed its original aspect and properties. When carbonic acid is simply inclosed in a caoutchouc bag, it passes out rapidly through its walls. Oxygen does the same, though much more slowly. Here lies the explanation of the gradual deflating of pneumatic tires. Newly inflated tires deflate much more rapidly than those on which the pump has often been used, since the latter contain almost nothing but nitrogen, the oxygen having passed out through the tire without waiting for a puncture. The oxygen may be collected on the other side of a thin rubber partition. When tires are to remain inflated for a great length of time, they should be filled with nitrogen.—D'Arsonval, Comptes Rendus, June 26, 1899.

In a recent clinical lecture, Dr. Stewart McGuire exhibited a patient who illustrated the fact that skin grafts do not always acquire the color of the individual on whom they grow. "Some of you," said the lecturer, as quoted in The Southern Medical Record, "will remember this negro, whose leg was amputated in the clinic over a year ago. Owing to an effort to save too much of the limb, sloughing occurred in the flaps, and a raw granulating surface resulted over six inches in diameter. You will recollect that as soon as active suppuration ceased he was brought before you again, and the defect covered by Thiersch's method of skin grafting. Usually skingrafts are cut from the individual's thigh, but in this instance they were taken from the leg of a white man which had been amputated a few moments before. I remember telling you that it seemed a shame to mutilate black skin when so much white skin was going to waste, and expressed my belief, based on the investigation of Karg, that pigmentation would occur and that the white skin would gradually become black. The operation of skin grafting was a perfect success, and the patient was discharged in two weeks with a well healed stump. He comes back for exhibition to-day. The artificially formed skin is firm, pliable, and painless, but as white as the day it was implanted. Fortunately, owing to its position, it is a matter of no consequence. Had it been upon the face, and had the colors been reversed, there might be a lively suit for malpractice."

SELECTED FORMULÆ.

Process for Producing Gold-like Alloy from Copper and Antimony.—This invention, patented in Germany, covers a metallic alloy, to take the place of gold, which, even if exposed for some time to the action of ammoniacal and acid vapors, does not oxidize or lose its gold color. It can be rolled and worked like gold and has the appearance of genuine gold without containing the slightest admixture of that metal, besides being much cheaper than other precious and semi-precious metals as well as the compounds and alloys used as substitutes for precious metals. The alloy consists of copper and antimony in the approximate ratio of 100 to 6 and is produced by adding to molten copper, as soon as it has reached a certain degree of heat, the said percentage of antimony. When the antimony has likewise melted and entered into intimate union with the copper, some charcoal ashes, magnesium and lime-spar are added to the mass when the latter is still in the crucible. Although the action of this material admixture of flux is not entirely explained, the alloy loses thereby a certain porosity otherwise present, and an exceedingly great density of the cast metal is obtained. Same can now be rolled, wrought, hammered, and soldered like gold, and when polished has the appearance of genuine gold, while being considerably firmer than the latter.—Journal der Goldschmiedekunst.

Deodorized Cod Liver Oil.—Mix 400 parts of cod liver oil with 20 parts of ground coffee and 10 parts of boneblack, warm the mixture in an open vessel to 60° C., let it stand five days, shaking occasionally, and strain through linen. The oil acquires the taste of coffee.—Bull. de Pharm. de Lyon.

To clean oily bottles it is recommended to introduce two heaped tablespoonfuls (for every quart of capacity) of fine sawdust or wheat bran, and shake well to cover the interior surface thoroughly; let stand a few minutes and then add about 100 c. c. of cold water. If the bottle be then rotated in a horizontal position, it will usually be found clean after a single treatment. In the case of drying oils, especially when old, the bottles should be moistened inside with a little ether, and left standing a few hours before the introduction of sawdust. This method is claimed to be more rapid and convenient than the customary one of using strips of paper, soap solution, etc.—Pharm. Post.

French Polish for Boots and Shoes.—

Wax, yellow	18 parts.
Spermaceti	6 "
Oil of turpentine	66 "
Asphalt varnish	5 "
Borax in powder	1 "
Vine-twig black	5 "
Prussian blue	2 "
Nitrobenzol	1 "

Melt the wax and stir in the borax. In another vessel melt the spermaceti, and when hot, remove from the fire and stir in the asphalt varnish, previously mixed with the turpentine. Now add the wax and borax under vigorous stirring. Rub up the colors with a portion of the wax and borax, reserved for the purpose, to a smooth paste, and incorporate it with the rest of the mixture. The nitrobenzol is used simply as a perfume. To use: With a brush or rolled rag, apply to the leather, and spread well; wipe with a cloth, and polish with a brush. Any good vegetable black may be used, instead of that specified, and a portion of nigrosine may be added as an intensifier.—National Druggist.

Elastic Leather Polish.—

Resin	30 parts.
Gum turpentine	30 "
Oil turpentine	30 "
Sandarac	60 "
Shellac	120 "
Alcohol	900 "
Lampblack, best	15 "

Other pigments may be substituted, these being introduced after rubbing smooth with a little alcohol after the varnish has been formed.

Paste Polish for Tan Shoes.—

Yellow wax	4 ounces.
Oil turpentine	8 "

Melt on a water bath, strain, stir occasionally until the paste turns creamy, then add the following solution:

Nankin brown	15 grains.
Phosphin	5 "
Water	4 drachms.

Stir constantly until the mixture is perfect.—American Druggist.

Furniture Polish.—

Shellac, best quality orange	1,000 parts.
Resin	65 "
Venice turpentine	200 "
Alcohol	2,600 "

Mix and put in a warm place, agitating frequently until the resins are dissolved. Let stand for four weeks, or until completely limpid, then decant.

Laundry Blue Tablets.—

Ultramarine	6 ounces.
Sodium carbonate	4 "
Glucose	1 "
Water, a sufficient quantity.	

Make a thick paste, roll into sheets, and cut into tablets.

Liquid Glue.—In Germany a patent has been issued for a liquid glue made of:

Glue	100 grammes.
Water	150 "
Sodium salicylate	10 "
Oil of cloves	90 drops.

It is prepared by boiling in a water bath until it becomes liquid. The object of the sodium salt is to prevent setting.—Druggist's Circular.

TRADE RECEIPTS AND SUGGESTIONS.

New Method of Keeping Milk.—Latterly, fresh milk in bottles has been treated with oxygen and carbonic acid under pressure of some atmospheres. By this method it is said to be possible to preserve milk 50 to 60 days in a fresh state. The construction of the bottle is siphon-like. A bacteriological examination of the preserved milk is still out.—Zeitschrift für angewandte Chemie.

Liquor Colors.—For producing the respective liquor colors the following prescriptions are given:

Brown.—Sugar color.

Yellow.—Saffron, 1 gramme; prepared in alcohol, 100 grammes.

Green.—Curcuma, 10 grammes; indigo carmine, 5 grammes; prepared in alcohol, 100 grammes.

Red.—Cochineal, 10 grammes; potash, 2 grammes; dissolved in water, 100 grammes.

—Seifensieder Zeitung.

Spirit Proof Sealing Wax.—Melt 500 grammes of yellow wax, 100 grammes of carnauba wax, and 100 grammes of paraffine, and mix gradually with a compound of 500 grammes of red lead and 200 grammes of whiting. Then heat the whole with constant stirring until the mass begins to become thickly liquid. This wax is used for sealing alcohol casks and it is advisable to heat it for use in a small tin pan with a long, tapering spout, and to pour it slowly on the bung to be sealed.—Farben Zeitung.

Linoleum Wax.—1. (Seifensieder Zeitung.)—Melt 5 parts of yellow beeswax and 10 parts of carnauba wax; next, while lukewarm, add 35 parts of oil turpentine and 30 parts of benzine, stirring thoroughly, and fill in tin cans.

2. (Pharmaceutische Zeitung.)—White Mofetti wax 5 parts, and oil of turpentine 10 parts. This mass, soft as butter, is said to give excellent gloss, and, besides, has the advantage that Mofetti wax is cheaper than carnauba wax.

3. (Leipziger Droguisten Zeitung.)—Yellow ceresine 500 parts, yellow wax 50 parts, colophony 50 parts, oil turpentine 600 parts. To be colored with oil-soluble aniline yellow.

Anaglypta on Ceilings.—In reply to a question on this subject, the Deutsche Tapezierer Zeitung recommends to paste anaglypta wall paper on ceilings coated with size paint. The ceiling is first gone over neatly with the spatula, then sized, or, better still, coated with a wash of scalded thinned flour paste, pretty hot, to which about one kilo. of Venice turpentine is added per pailful. Another authority recommends size with an admixture of varnish. It is said to be best, however, to coat the ceiling, after treatment with the spatula, with varnish only, and to do the pasting on after same is dry. For paste, scalded flour paste is recommended, to which, while warm, heated Venetian turpentine is added, about 250 grammes to 20 to 30 square meters of surface.

Washable Plaster Casts.—Coating or saturating the cast with a neutral soap from stearic acid and soda lye dissolved in ten times the quantity of hot water is recommended. Cleaning of dust may be done with lukewarm water. Of special merit, however, is the following process: Leave the plaster of Paris casts after complete drying for twenty-four hours in a cold barytes solution, wash them off carefully with cold water after removal, so as to eliminate the adhering barytes entirely, and allow them to dry three to four days at an ordinary room temperature. Next put them for a short time (about one-half hour) in a hot solution of one part grain soap in fifteen to twenty parts water, and dry them finally, after the adhering soap particles have been removed with water, in suitable drying rooms.—Deutsche Maler Zeitung.

Test and Composition of the Acetone Oils.—For the estimation of the acetone oils obtained from the wool wash-water, the determination of the specific gravity, of the solubility in water and sodium disulphite, and of the parts boiling between 70° and 90° C. is sufficient. Before conducting the test, the sample is dried with potassium carbonate. The density lies between 0·830 and 0·835. 77 to 82 per cent. of acetone oil dissolves in water when 10 c. c. are agitated with 40 c. c. of water in the graduated tube. In sodium disulphite solution of 30° Be. 91 to 94 per cent. of oil is dissolved, 350 parts of sulphite solution being used for 100 parts of oil. In distilling about 74 to 80 per cent. pass over at between 70° and 90° C., consisting mainly of ethylmethyl ketone. An acetone of commerce, distilled from pyrolignite of lime, showed a density of 0·842, 44 per cent. of parts soluble in water and 91 per cent. soluble in bisulphite. Between 70° and 90° C., 36 per cent. distilled over. Hence this acetone is not inconsiderably different from that obtained from wool wash-water, being especially more deficient in ethylmethyl ketone and rich in ketones boiling at above 100° C.—Comptes Rendus, 128, 561, through Chemisches Centralblatt, 1899, 862; P. and A. Buisire.

Copying Process on Wood.—If wood surfaces are exposed to direct sunlight, the wood will exhibit, after two weeks' action, a browning of dark tone in the exposed places. Certain parts of the surface being covered up during the entire exposure to the sun, they retain their original shade and are set off clearly and sharply against the parts browned by the sunlight. Based on this property of the wood is the sun-copying process on wood invented by Ernst Pliwa and Joseph Weiss. The method is used for producing tarsia in imitation on wood. A pierced stencil of tin, wood, or paper is laid on a freshly planed plate of wood, pasting it on in places to avoid shifting, and put into a common copying frame. To prevent the wood from warping, a stretcher is employed, whereupon expose to the sun 8 to 14 days. After the brown shade has appeared, the design obtained is partly fixed by polishing or by a coating of varnish, lacquer, or wax. Best suited for such works are the pine woods, especially the five-year fir and the cembra pine, which, after the exposure, show a yellowish brown tone of handsome golden gloss, that stands out boldly, especially after subsequent polishing, and cannot be replaced by any stain or by pyrography. The design is sharper and clearer than that produced by painting. In short, the total effect is pleasing and handsome.—Neueste Erfindungen und Erfahrungen.

HISTORIC CAVALCADE OF ETIENNE MARCEL.

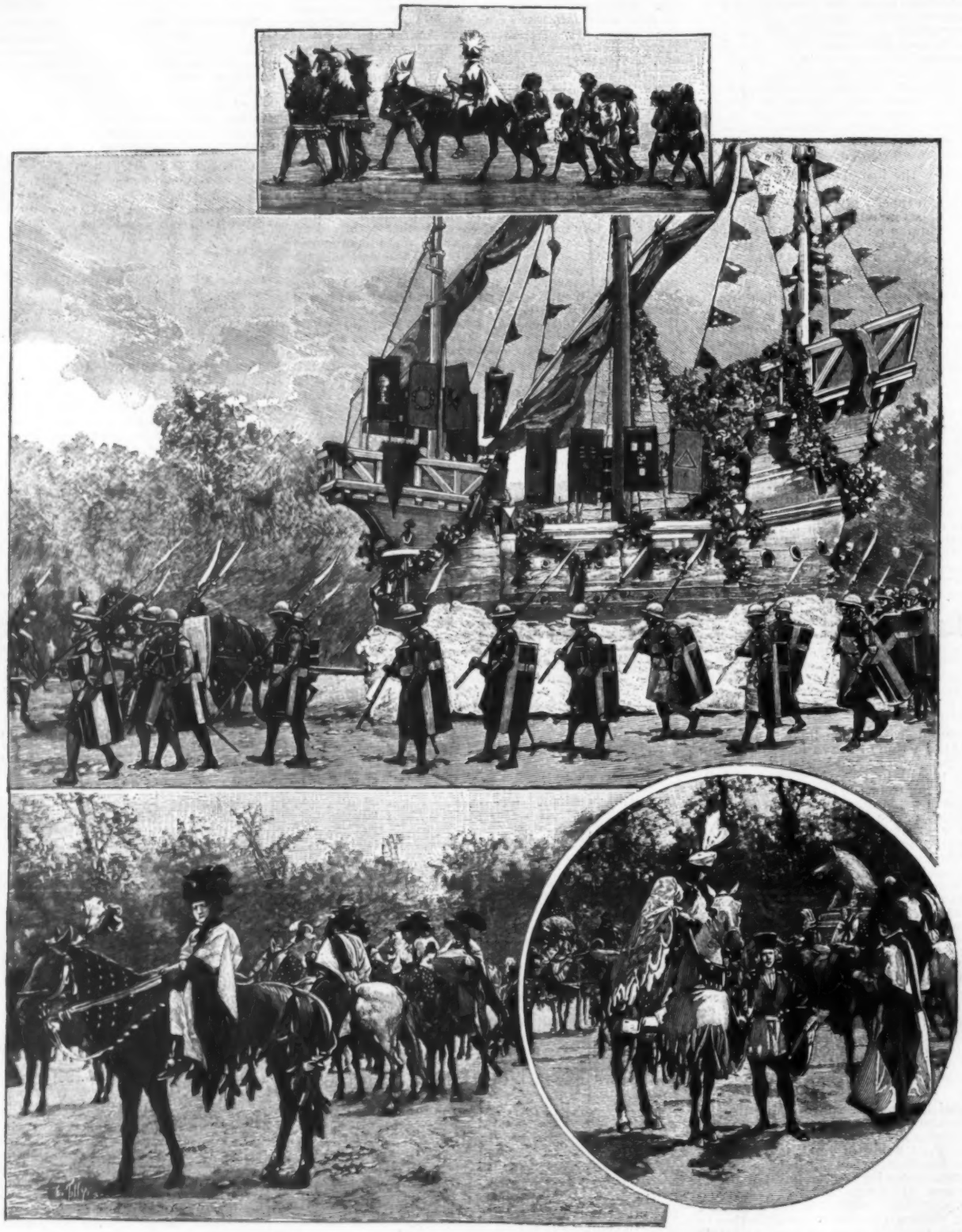
THE cavalcade organized by the committee on the Paris fêtes was very fine in itself, and would not have failed to prove a success had it not made its appearance before a public which was not expecting to see it, at least on the first day. Sufficient publicity had not been given it.

It was a question of showing the Parisians of 1899 what their ancestors were like about five centuries ago, in the time of Etienne Marcel. The procession included all the trades of Paris in the picturesque costumes of 1530.

The corporations, with the master-workmen at the head, advanced in the following order: The bakers, dressed in white; the masters of the cook-shops; the joiners, preceded by a music float; the potters; the founders; and the goldsmiths. Then came the King of Fools mounted upon an ass and surrounded by a cortege of buffoons. A group of trumpeters on horseback preceded the float of the Seine, upon which walked about a pretty woman raised to the rank of a nymph. Finally came Etienne Marcel himself. The celebrated provost of the merchants, clad in a robe of golden brocade, made his appearance preceded by mounted watchmen, mace bearers, and musicians. The procession was closed by a large float representing the body of the vessel of the arms of the city of Paris.

The costumes, which were designed by MM. Bianchini and Betout, were of irreproachable historic accuracy. The decorative part, due to MM. Colmet d'Aage, Marcel Jambon, Wallé, Halli, and Berard, left nothing to be desired. Finally, there is reason to congratulate M. Maillard, the Organizer-in-chief of the fête. This historic cavalcade, however, was only half a success. Paris is too much accustomed to seeing the magnificent pageants of the Opera, Chatelet, and other theaters to interest itself in street spectacles. And then, again, Paris is too large. A historical procession is interesting in a provincial city because the protagonists of the fête are known to everybody, and so the affair becomes a costumed fête among friends.

For the above particulars and the engraving we are indebted to L'Illustration.



HISTORIC PROCESSION DURING THE FÊTES OF PARIS.

1. King of the Fools. 2. Float of the City of Paris. 3. Aldermen. 4. Etienne Marcel.

TRADE WITH THE PHILIPPINES, PORTO RICO AND CUBA.

CUBA, Porto Rico, and the Philippines afforded a market for over $40,000,000 worth of Spanish goods per annum, according to a statement of the British consul at Barcelona, just received by the Treasury Bureau of Statistics. About three-fourths of this amount was in manufactured goods, and considerably more than one half of this market was that of Cuba alone. According to the statement which Mr. Consul Roberts sends to the British Foreign Office, dated June 18, 1899, the exports of Spain to Cuba in 1896 amounted to 134,461,675 pesetas; to Porto Rico, 37,660,809 pesetas; and to the Philippines, 38,357,757, making a total of 210,480,241 pesetas; and accepting the value of the peseta at 20 cents, makes a total of $42,096,048. Of the 134,461,675 pesetas value of goods exported to Cuba in 1896, 82,652,093 pesetas, according to Consul Roberts, consisted of manufactured goods, 50,850,556 provisions, and 959,026 of raw materials. Of the 37,660,809 pesetas value of goods exported from Spain to Porto Rico in 1896, the value of 29,107,977 pesetas was manufactured goods, 8,401,501 provisions, and 151,321 pesetas raw materials. To the Philippines, of the 38,357,757 pesetas value of goods exported from Spain, the value of 34,250,892 pesetas was manufactured goods, 4,070,557 provisions, and 36,308 raw materials. Totalizing the three colonies, Consul Roberts finds that of the 210,480,241 pesetas value of goods exported from Spain to Cuba, Porto Rico, and the Philippines in 1896, the value of 146,010,962 pesetas was manufactured goods, 63,322,624 provisions, and 1,146,655 pesetas raw materials.

To this market for $42,000,000 worth of Spanish produce, which the three colonies supplied, Mr. Consul Roberts adds 23,000,000 pesetas, or $4,600,000, for money paid to the Spanish steamship companies for the carrying trade to and from the colonies. The imports into Spain from the colonies, he says, amounted in 1896 to 260,877 tons from Cuba, 26,071 tons from Porto Rico, and 40,985 tons from the Philippines, and computes that the amount paid in freight amounted in the commerce with Cuba to 7,826,310 pesetas; Porto Rico, 782,130; and the Philippines, 2,254,175, or a total of 10,862,615 pesetas, and says: "If to this be added the value of passage money to and from the colonies, putting it at the low average of 250 pesetas a head, it shows a further 13,000,000 pesetas per annum, giving a total of 23,000,000 pesetas per annum paid in freight and passage money to the steamship companies for the carrying trade to and from the colonies.

Consul Roberts expresses the opinion that Spanish manufacturers and dealers are not going to give up the

markets of Cuba, Porto Rico, and the Philippines without a struggle. He also intimates that other nationalities have in the past participated in the so-called Spanish trade with these islands by locating in Spain and thus getting the advantage of low tariff rates into the islands which was originally given to commerce originating in Spain. On this subject, he says: "In the year 1892 the Spanish customs tariff on manufactured goods was very considerably increased, with the view of virtually giving a monopoly to goods manufactured here for exportation to the colonies; this, of course, gave an enormous impetus to manufacture in this province, factories increased largely in number, and the Catalan manufacturers grew rapidly rich. The only way in which foreigners who had good clients in the colonies could meet this competition and retain their markets was by starting factories in the country, the goods thus being manufactured in the peninsula entering the Spanish colonies on the same terms as those of the Spanish manufacturers, whereas if shipped from England or elsewhere the prohibitive duty rendered competition impossible; or by having a resident agent in this city who, purchasing from the Catalan manufacturers, exported the merchandise from here free of duty."

BUILDING RAILWAYS IN THE FIELD BY THE RAILWAY CORPS OF THE GERMAN ARMY.

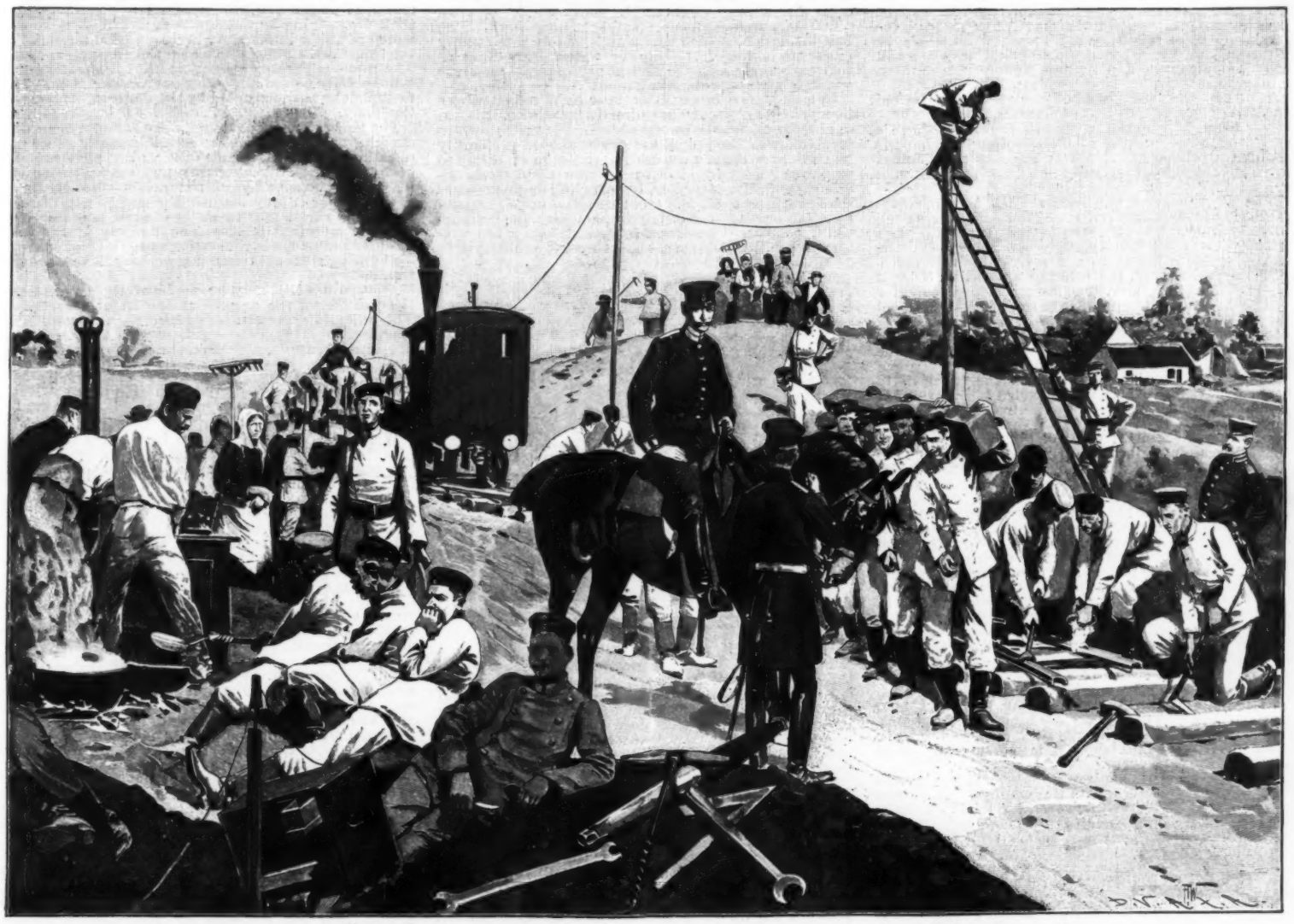
THE great importance of railroads in modern warfare was clearly shown in the Franco-Prussian war of 1870–71. To assure not only the transportation of mobile bodies of troops to their rendezvous, and the placing of them in strategical positions, but, also, after the opening of hostilities, the requisite reinforcements of troops, and the forwarding of fresh supplies of water, provisions, and munitions, as well as the return of the wounded and prisoners, requires the most thorough preparation in time of peace. Such railroads are of special importance, however, when they are laid in the field, as is the rule in sieges. It would doubtless be possible to lay the track with the normal gage used on the state railroads, but in most cases a narrow gage track will be preferred, as the construction then requires less material and time, and can be accomplished with little labor.

The German railway corps has gradually developed since the last campaign, and the railway brigade now consists of three regiments of two battalions each, with four companies to a battalion. Our illustration shows a division of the railway brigade at work. A narrow gage branch line is being laid over the open fields with all possible dispatch to connect with a line already existing. The pioneers of the various companies are divided into different divisions, each of which has a different task to perform. The co-operation of the whole troop goes on like clockwork, and is the chief reason for the rapid progress of the work.

The material for the railroad is prepared in time of peace, and is carried into the field. It consists of rails, sleepers, and rolling stock. The rails are about two feet apart, and are laid in short sections sufficiently light to be carried by the men. Each section consists of a pair of rails fastened together at the proper gage by iron yokes. The yokes are laid on the sleepers and fastened to them. In the foreground of our picture may be seen a division of men doing this work. Another division has laid the sleepers. A third division is carrying forward the sleepers which, together with the other materials, have been brought up from the supply station over the line of track just built. The locomotive and construction train are seen in the background, with men unloading the material.

Still other divisions are employed in the laying out of the line and in construction of bridges, embankments, cuttings, and the like. The members of the railway corps are also trained to build bridges capable of carrying the heaviest loads. Rapidity of construction is the chief consideration in laying narrow gage tracks, and it is for this reason that the troops avoid as many of the obstacles as possible that they encounter in the field. The superstructure is simply laid upon the ground and the material is so constructed that it readily conforms to the inequalities of the soil and can be bent in sharp curves. In this manner about ten kilometers of track are constructed daily.

Telegraphic and sometimes telephonic communication is indispensable in the management of a railroad. This is likewise necessary in a field railroad, where, progressing uniformly with the rapidly constructed track, a field telegraph line is also built by a specially trained company of the railroad brigade.



BUILDING RAILWAYS IN THE FIELD BY THE RAILWAY CORPS OF THE GERMAN ARMY.

In the foreground of the picture an open box will be noticed near a group of resting men. In this is carried the field telegraph apparatus, while the wire leading from it shows that a temporary station at this point places the end of the advancing railroad in communication with the base of supplies by means of the telegraph wire which has just been strung. Near the telegraph station are seen the cooks preparing dinner for the men in improvised field kitchens. There is no doubt that after the arduous labor of building the railroad, the appetites of the latter will do justice to the food.

We are indebted to Illustrirte Welt for our illustration and description.

ELECTRICITY IN COAL MINING.*

By JOHN PRICE JACKSON and FRANK F. THOMPSON.

THE statements in this short paper on the use of electricity in mines refer especially to the mining of soft coal. Of the essential elements in operating such mines, two of the most important are: First, apparatus to obtain efficiently the rapid handling of the coal; and second, to do this with the least possible number of openings. These conditions have evidently been large factors in causing the application of electricity to such operations.

The applications of power to mines, which we wish to consider, are principally for (a) lighting, (b) haulage, (c) cutting or drilling, (d) pumping and driving fans.

Systems.—The systems worth considering which are in use at present may be tabulated as follows:

1. Rope haulage and steam for all other purposes.
2. Electric haulage and compressed air for other purposes.
3. Electric haulage and electricity for other purposes.

Various other combinations are of course used, but these three will serve the purpose as representing well-defined types.

Rope Haulage and Steam Power.—In the past, this system has been the standard, and even yet in many portions of the hard coal fields has a very firm hold. Experience has shown rope haulage much inferior to electricity in point of working economy, as is now being illustrated by the continual substitution of electric for rope haulage now going on in the soft coal field.

The Mitchell Coal and Coke Company had two mines running for some time at Gallitzin, Pa., under exactly similar circumstances, but one using rope, the other electric haulage. It was quickly proved that the electric was far preferable.

Steam power for pumps and fans in the mines has likewise been shown by experience to have many faults. Timbers along which the pipes pass rapidly deteriorate. The piping is expensive to install and can only be kept in good condition by constant attention. If the lines are long, they are a source of large loss of power by radiation and condensation, even when well covered. They are a nuisance in the mines because of their high temperature. The steam motors are expensive from the standpoint of repairs and attention. Steam cutting and drilling will in most cases prove unwieldy. Mines operated under this system are without suitable means of lighting, an important matter in rapid operations.

Electric Haulage and Compressed Air Power.—The Berwind-White Company's mines at Windber, Pa., furnish an excellent example of this system, and so far as known it has given complete satisfaction. This plant, which has now six mines in operation with an output capacity of 5,000 tons per day, is eventually to be increased to ten mines with 10,000 tons capacity. The haulage in the mines is done by electricity, while the drills, interior pumps, and fans are driven by compressed air. The use of compressed air has many obvious advantages. It is found that the machinery, working under the extremely severe conditions to be found in a mine, performs its duty well. It requires little attention and is thoroughly reliable. On the other hand, pipe lines in extended mines are expensive to lay and keep in repair. The pipes soon deteriorate, and when the lines are removed from old workings, it is usually found that much if not all the pipe is in too bad shape for further use.

*A paper presented at the Sixteenth General Meeting of the American Institute of Electrical Engineers, Boston, June 27, 1899.

The flexibility of the system, or its adaptability to quick changes, is not satisfactory.

Electric Haulage and Power.—For convenience in discussion, this head may be divided into two subsystems as follows:

(a) Direct currents for haulage and other power.

(b) Direct currents for haulage and polyphase currents for other power.

The use of direct-current machinery for pumping and fans has not been found satisfactory in many instances. One large company after a thorough trial of such apparatus rejected it in favor of compressed air. The pumps in a mine are subject to only rare inspection, and that, oftentimes, by unskilled workmen. These conditions combined with the unfavorable location of the machinery will soon cause electrical troubles in the commutator, or elsewhere, of the most carefully constructed motor. Inasmuch as the stopping of a pump, even for a short time, may cause excessive damage, the use of such a motor is a constant menace.

The second electric system, that using direct and polyphase currents, has the inherent disadvantage of requiring the installation of two distinct and separate sets of generators and wiring. This is a matter of serious importance, as indicated later, but is neither so expensive nor cumbersome as the piping used for compressed air. The great advantage in the use of polyphase currents lies in the fact that they permit the use of a motor that is perfectly reliable under essentially all conditions of operation to be met with in mining. This compound electric system seems without doubt to be the best that can be installed for large operations. It comprises the advantages of all the other systems while eliminating their most serious defects. A system using polyphase currents alone might possibly prove more advantageous, but would have the serious defect of requiring two trolley wires, and even if this difficulty were overcome, it would have to await the development of a polyphase motor suitable for a mining locomotive.

The Davis Coal and Coke Company.—The Davis Coal and Coke Company's plant at Thomas, West Virginia, is so efficiently equipped with this compound electric service as to be worthy of a short description. The company operates two mines at Thomas, the Thomas drift and the Davis shaft, and one mine at Coketon, a drift.

The power station is a roomy brick building containing Ames 200 horse power engine direct connected to a 150 K. W. 500-volt direct-current generator; two Atlas cycloidal heavy duty engines of 150 horse power, one of which is belted to a 100 K. W. 550-volt three-phase alternator, and the other to a 76 K. W. 550-volt direct-current generator. The last mentioned generator has been installed temporarily in the place of a second 100 K. W. three-phase 550-volt alternator which had been operated in parallel with the other three-phase alternator. This 75 K. W. machine is used to help the haulage generator.

The coal is hauled by horses from the "rooms" to convenient points, where it is collected into "trips" of from six to twelve "wagons." The inside haulage motor, a 14-ton G. E. T. M. M. 35, takes these "trips" and hauls them to a central point of the breast, and there they are combined into larger "trips" of about 15 to 35 wagons and hauled to the mouth of the mine by another similar motor. Each of the haulage motors gives 3,500 pounds drawbar pull. At Coketon, two miles away, another 14-ton haulage motor is installed.

The alternating three-phase generator is used for operating three 10 horse power induction motors for driving small pumps, one 5 horse power, one 10 horse power, two 20 horse power, and one 30 horse power induction motor for operating elevators; one 5 horse power induction motor for a car lift; and three G. E. chain coal cutters. The induction motors for driving the pumps are located at the foot of the side entrance both at Thomas and Coketon. One 10 horse power induction motor connected to a pump having a 5-inch suction 250 feet long, and a 4-inch discharge pipe 750 feet long, with a total elevation of 28 feet, pumping 106 gallons per minute, was tested and found to take 11,000 watts. Induction motors are also used for driving fans, and conveyors which carry the slack coal from beneath the screens to the bins where it is stored until needed to charge the coke ovens.

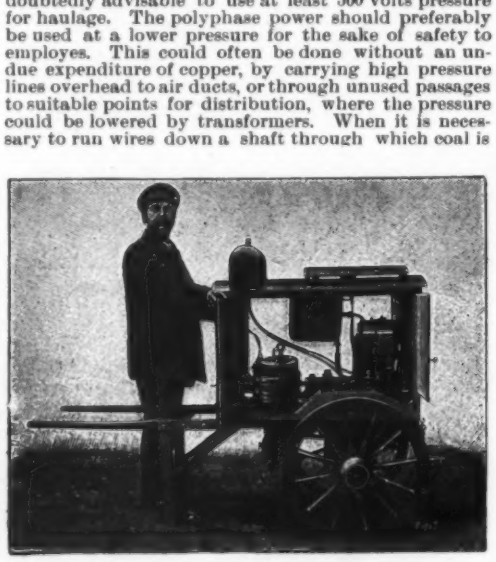
Haulage.—Electric haulage equipments have been so long in use as to be now in a thoroughly good state of development. Even yet, however, the following faults may be observed in some of the machinery: Poorly acting brakes, unwieldy arrangement of the various controlling levers and trolley poles, brake rods or other projections too close to the track, and unsatisfactory speed and power regulation. Although some of these seem of small importance, any one of them is apt to seriously interfere with efficient work. The brakes on a mining locomotive should be very powerful and quick acting, likewise the arrangement of motorman's seat, brake handle, controller and sand box lever should be such that the motorman can control his machine with the greatest possible dispatch and ease. Locomotives have been placed in mines with absolutely no provision for the motorman, and others where the lever arrangements are so unwieldy as to make the quick control necessary to safe operation impossible. In large coal operations economy is often to a large extent dependent upon the rapidity with which the wagon trains can be moved. Heavy grades both in favor of and against the load are frequently to be found. In order to draw a large load and make quick time, the design and control of the motor should be such as to give an unusually great draw-bar pull at low speed, and at the same time have points of comparatively high speed. This condition is not properly met at present by all of the mining locomotives in operation. In one mine, which has come recently under the writer's observation, a slightly different design and arrangement of control in the locomotive would permit the handling of much larger loads at a great saving.

Electric Pumps.—Electric pumps run by induction motors give very satisfactory service. The conditions met with in mining often necessitate frequent relocation of the pumps and in this respect the electric pump is by far the most satisfactory. The attention required is certainly a minimum. A particular pump tested ran about ten hours per day, and the only attention required was that necessary for starting, stopping, and lubrication. Some mine owners have objected seriously to the electric pumps. In most cases these objections have been due to the compact arrangement of the pump and motor. In one mine which came under our observation, a 10 horse power pump, which was bought with the motor, was replaced by the water end of a steam pump with a great improvement in the service. If electric motors were made to suit the pumps, and not the pumps to suit the motors, it would go far toward obviating the most serious objections. When the pump must be of large capacity, and when it can be located within a reasonable distance of the steam plant, a steam pump would probably show greater economy.

Wiring and Pressure.—Wiring in mines is subject to certain restrictions which do not apply in ordinary wiring. There is no doubt that the 550 volts used for haulage is dangerous for horses. It is therefore customary in many mines to shut off the trolley current while the mules are being taken in or out of the mines. If a polyphase system is installed for operating cutters, pumps, etc., in the mine, it should be run through the air courses, and not through the main gangway. A pressure of 550 volts alternating is much more dangerous than the same direct-current pressure. The class of labor which is usually employed in the soft coal fields is of a low grade of intelligence, and many instances are recorded of serious personal injury or loss of life from accidental or intentional contact with the wires on both 500-volt A. C. and D. C. service. Although the mine laborers may have been repeatedly warned of the danger, they continue careless about the wires. When the mine roof is low enough to be reached by the men, the common practice is to run trolley wire along one side supported by the usual hangers. When feeders are necessary they should be run along the same side. The other side of the roof should be kept clear.

Ordinary bare wire is preferable in mine work. The best insulation, rubber compounds, deteriorate rapidly under the action of the sulphur water. Any other insulation soon becomes inefficient owing to the moisture which is always present in a mine.

In large operations such as those at Windber, where twenty miles of trolley are already in service, it is undoubtedly advisable to use at least 500 volts pressure for haulage. The polyphase power should preferably be used at a lower pressure for the sake of safety to employes. This could often be done without an undue expenditure of copper, by carrying high pressure lines overhead to air ducts, or through unused passages to suitable points for distribution, where the pressure could be lowered by transformers. When it is necessary to run wires down a shaft through which coal is to be hoisted, the best practice would be either to use lead-covered cable, or wire which has been insulated with rubber, heavily braided, and drawn into an iron conduit having the ends hermetically sealed. In many instances when wires have been installed without such protection, in old shafts, trouble has resulted from the breaking of the wires, caused by lumps of coal falling down the shaft, etc.



MOVABLE ELECTRIC GENERATOR.

Skilled Employes.—Too much pains cannot be taken to employ careful men as motormen for the haulage motors. The mine track is far from being up to the street railway standard. To haul a long trip of wagons over a bad track requires careful handling of the motor. The motorman should be trained to study his track and his load, and know when and where to let his trip run slack and where to keep the couplings taut. A case came under the writer's observation where a careful motorman handled a trip of fifteen loaded wagons, while another motorman stalled with ten wagons on the same stretch of track. This matter is a very important one from the mine owners' point of view. The cost of driving gangways and shafts is considerable, and any method which will allow of an increase in the quantity of coal which can be taken from a single opening in a given time adds very materially to the mine owners' profits.

Lighting and Signals.—As the lighting of a mine is a comparatively simple matter, it is scarcely necessary to consider it here. The universal method is to light up all switch points, and only other places of exceptional importance. In large mines using a number of locomotives, an efficient system of signals should be used in the main headings. This should be an automatic block system. Mr. A. S. McAlister, of Windber, Penn., has worked out such a system, using incandescent lamps between trolley and rails, which is working admirably.

Efficiency.—The question of efficiency, from a fuel standpoint, is of comparatively small relative value, as the difference in actual cost in fuel in the different systems is insignificant, when compared with other expenses. Data available seem to indicate, however, that the all electric systems lead in this respect. As regards the total commercial efficiency, including maintenance, labor, interest, and depreciation, there can be no doubt but that the compound electric system, using polyphase and direct currents, will give the best results.

General.—The data and statements presented in this short paper are gathered from personal experience in the mines, from mine superintendents, and from student thesis work carried on under the supervision of the Pennsylvania State College. In writing the paper, it was not intended to give a complete detailed treatise on the use of electricity in mines, but to outline the most important conditions and facts bearing upon such utilizations.

MOVABLE ELECTRIC GENERATOR.

Electricity may be made to perform great service in any small manufacturing plant. The transmission of energy by electricity is certainly the most advantageous method of producing motion. This is so not only for great power at long distances, but also for a very small amount of power for a short distance of several yards. Electric motors are easily adapted to operate simple machine tools, drills, boring machines, etc. They may be moved about with ease, will work well under favorable conditions, and require but little attention when being operated.

The great difficulty was to produce electrical energy easily at any given place and to have a source of energy sufficiently movable and light to be moved about wherever it is needed.

M. Albert Collet has recently devised a movable electric low power generator which solves the generator problem. He uses a four horse power motor, similar to those used in automobiles. This motor is connected with a small dynamo by gear wheels. As will be seen in our illustration, the motor and dynamo are mounted horizontally on a frame, which is supported by a single axle and pair of wheels on one end and handles and legs on the other. The handles allow of its being wheeled about wherever it is needed. Above the motor and dynamo is a roof, below which is placed a water tank for keeping the motor cool, and on the top of which is the fuel tank containing the gasoline. Below the frame is a muffler into which the engine exhausts. The whole apparatus weighs about 1,100 pounds and can be easily moved about by one or two men. The first model was constructed by the Panhard & Levassor Company.

The generator was devised by M. Collet for operating machine tools, but there are certainly many other applications that can be made of it which have not yet been thought of. Among these, we may mention the lighting of shops and yards that are beyond the limits of the regular supply mains. Enough power may be had to light from four to six arc lamps and thirty or forty incandescent lamps. The Railway of the East has used one of these generators since the first of April for lighting their subterranean works at Torcenay near Chalindrey.

Another use that may be made of the generator is the charging of the accumulators of motor carriages. This will allow the owners of electric automobiles to charge their carriages where there is no regular source of electrical supply, such as in the country for example.

MOTOR SPEED REGULATION.*

By Alton D. Adams.

While great advances have been made in the application of alternating machinery, the distribution of power by direct currents was probably never increasing faster than to-day.

Tens of thousands of horse power are now delivered by direct current motors, and a large part of this work is done at variable speed.

In spite of this extended use, the direct current motor as commonly used for variable speed is by far the least efficient link between the central station engine and the consumer's machinery.

This lack of efficiency is by no means inherent in the motor, but results from the common method of speed regulation by the use of a variable resistance in the armature circuit.

As the case now stands, the central station furnishes about 80 per cent. of the power developed by its engines to consumers. Manufacturers provide motors of from 80 to 90 per cent. efficiency at full speed and load, and the user in order to regulate the speed to his requirements commonly employs a method of regulation which reduces the efficiency of his motor to 50, 25, or even 10 per cent.

Consider, for example, a motor having an efficiency of 86 per cent. at full load and speed, with losses of 3 per cent. in armature windings, 3 per cent. in shunt magnet winding, and 8 per cent. local currents, friction and hysteresis.

Let this motor be loaded to full and constant armature current and then regulated for variable speed by a resistance in the armature circuit.

As the energy entering the armature circuit is 97 per cent. of that drawn from the line, and the loss in armature winding is 3 per cent. of the total, this winding loss is $0{\cdot}3 \div 0{\cdot}97 = 3{\cdot}09$ per cent. of the energy entering the armature circuit.

The pressure required to force the full current through the armature resistance is, therefore, 3·09 per cent. of the line pressure.

The counter electromotive force of the armature at full speed will be $100 - 3{\cdot}09 = 96{\cdot}91$ per cent. of the line pressure, and at one-fourth speed the counter electromotive force will be $96{\cdot}94 \div 4 = 24{\cdot}22$ per cent. of the line pressure.

At quarter speed, then, the rheostat in armature circuit must consume $100 - (3{\cdot}09 + 24{\cdot}22) = 72{\cdot}69$ of the line pressure; and as 97 per cent. of the total energy is delivered to this circuit, the rheostat in this case consumes $97 \times 0{\cdot}7269 = 70{\cdot}5$ per cent. of the energy taken from the line.

Assuming that the losses from local currents, hysteresis and friction vary directly with the speed, the losses internal to the motor at one-quarter speed became $(8 \div 4) + 3 + 3 = 8$ per cent., and the total losses in motor and regulator became $70{\cdot}5 + 8 = 78{\cdot}5$ per cent., thus giving the combination an efficiency of $100 - 78{\cdot}5 = 21{\cdot}5$ per cent. at one-quarter speed.

At less than constant torque and armature current, the combined efficiency will evidently be lower than above figures.

As there are well known methods of speed regulation which involve only the small losses internal to motors, whatever the speed, it seems that a stronger effort on the part of manufacturers to introduce ma-

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chines with efficient means of speed regulation would benefit all concerned.

Two practical methods of motor speed regulation are the variation of magnet strength and the variation in arrangement of armature conductors as to each other.

A rheostat in the shunt magnet winding gives any desired speed above the minimum, with constant armature capacity, and two or more separate windings and commutators on the armature give two, three, or four times the minimum speed, with corresponding increase in armature current capacity.

The work required of variable speed motors is of three kinds, namely, constant whatever the speed, varying directly as the speed, and varying directly as same power of the speed.

These three classes of work are illustrated by machine tools, which require, when in use, nearly constant power for all speeds, by shafting which consumes power nearly as its speed, and by centrifugal fans whose driving power varies as the cube of their speeds, friction aside.

As constant power at all speeds involves a constant armature current, it is well provided for by a variable magnet strength to correspond with all desired speeds, but special proportions are necessary to avoid sparking with a constant armature reaction and weak magnets at the higher speeds.

When the required power and consequently armature current varies directly with the speed, the armature reaction, winding loss and magnet strength may be held constant and the desired speeds secured through two or more separate windings and commutators, provided a reduction of the maximum speed to one-half or one-quarter is sufficient.

If the power and armature current must vary as the cube or other high power of the speed, it is well to combine the method of multiple armature windings with the variation of magnet strength, as the variation of armature conductors which gives the desired speed does not in this case afford proper current capacity.

It is certain that motors constructed for above methods of speed regulation will cost more than those of ordinary type, whose speed can only be regulated by a resistance in the armature circuit.

It is equally certain that the saving of energy effected by the more efficient means of speed regulation will soon offset its increased cost in any given case.

Efficient means of regulation in variable speed motors will benefit manufacturers through the sale of more valuable machines, the consumer by a reduction in power bills, and central stations and manufacturers alike in the increased use that a large reduction in the cost of operation will produce.

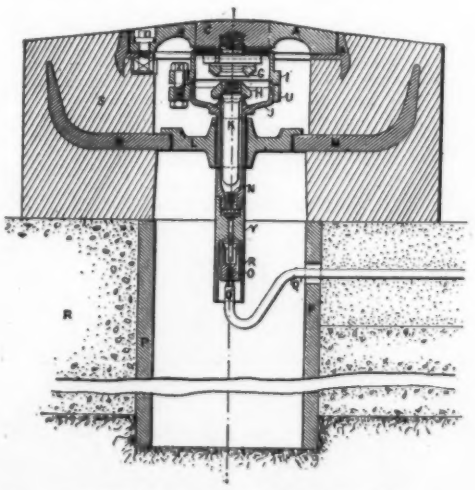
Attention is called to these facts, not because they are new, but because their importance entitles them to more consideration than they have received.

THE ELECTRIC TRAMWAY OF THE CITY OF TOURS.

IN the city of Tours a new electric tramway has been completed which operates upon the Diatto system.

The system in question belongs to that class in which the current generated in a central station is conducted to the cars along the line by means of contacts placed between the rails level with the ground. The first application of the system was made in Paris; the second in Monaco; and the third in Tours.

Briefly stated, the system consists in connecting an underground insulated cable with a series of successive contacts. It is of prime importance that these contacts be placed in communication with the feed cable only when the car or the special device carried by the car is immediately over one of them, and that the circuit be broken when the car has passed. These objects are attained by means of a device mounted in the interior of a paving stone, and consisting of a large iron pin with a broad head, the shank being immersed



SECTION OF CONTACT-BLOCK.

in a cup of mercury to which the electric current is conducted by means of a wire connected with the main insulated cable.

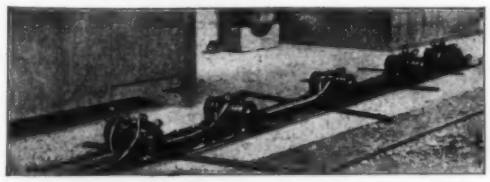
The magnetic device mentioned is hung beneath each car and successively touches the surface contacts. In passing over one of these, the pin is strongly attracted and raised by the magnet while the lower portion of the shank is still immersed in the mercury, the head, however, abutting against the roof of the chamber in which it is contained. By reason of this automatic upward movement, a connection is made between the car and the main cable, so that the current is enabled to pass from the cable, through the branch wire, through the mercury and the pin, to the roof of the chamber, and thence through the magnetic device to the car.

The surface contacts are separated from one another less than the length of the frame carrying the magnetic device, so that there is always one contact in electrical communication with the device. The motors are hence always supplied with current. The body, *S*, of the paving stone carrying the contact is an asphalt block which rests upon a hollow sandstone cylinder, *P*, the openings in both cylinder and block being in alinement.

Between the rails the blocks in which the contacts are contained are seated in a bed of cement, and the joints are filled with asphalt in order to prevent the exhalation of the odors arising from the stagnant water accumulating between the rails.

In each asphalt block an opening is formed which receives a movable cap, *A*, composed of a non-magnetic metal and surrounding a central plug, *C*, of soft iron. The cap, *A*, rests upon a bronze ring, *B*, sunk in the asphalt and held in place by three bolts.

A casting, *M*, of great magnetic permeability is embedded in the block of asphalt and supports a cross-piece, *L*, the middle portion of which is provided with a sleeve through which passes the reduced portion of



CIRCUIT-CONTROLLING MAGNETS.

an ebonite mercury cup, *J*. The piece, *M*, terminates in upwardly turned wings embedded in the asphalt body, *S*.

Into the lower portion of the cup is screwed a copper plug, *N*, provided with a copper wire leading to the mercury in a second metallic cup, *O*, communicating with the conductor, *Q*. In the mercury contained in the first or ebonite cup, the shank, *K*, of the iron contact pin normally floats, in the position shown. The pin is so poised on the mercury that a very small magnetic attraction will suffice to draw it up.

The head of the pin is surrounded by a carbon ring, *H*, of great strength and conductivity. The soft iron plug, *C*, mounted in the center of the cap, *A*, receives a screw plug, *D*, also provided with a carbon ring, *G*, adapted to engage the carbon ring, *H*. The ebonite cup is attached to a brass bell, *I*. The tube, *R*, forms a continuation of the ebonite cup and constitutes an air-bell, the air in which prevents the rising of the water which may accidentally reach this portion of the apparatus. It is claimed that by this arrangement the contacts of the apparatus are all effectually protected from water.

The magnetic device carried by the car is composed of one central bar and two side bars, carrying five electro-magnets mounted on springs electrically insulated from the frame and from the coils of the magnets. The polarity of the central bar is north and that of the two outer bars south. The electro-magnets have two distinct windings, so as to obtain two degrees of excitation. Normally they are energized by the main current conducted through the coarser winding.

In starting the car a small accumulator battery is used, the current from which (5 to 6 amperes under a tension of 30 to 32 volts), passing through the coils of

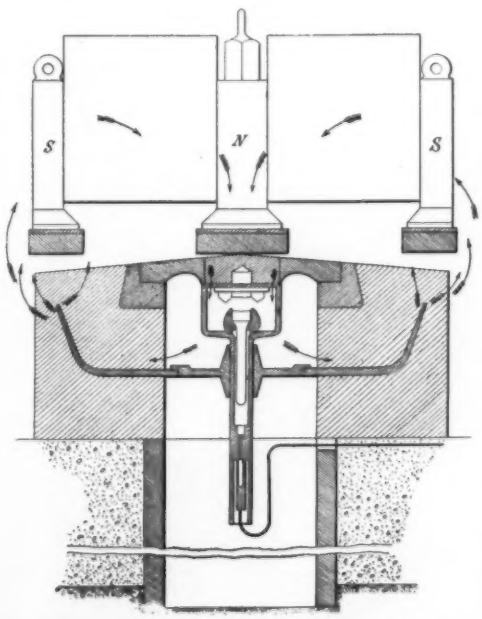


DIAGRAM OF THE MAGNETIC CIRCUIT.

fine wire, excites the electro-magnets. The dimensions of this battery are 850 mm. × 350 mm. × 380 mm. (33·405 inches × 13·755 inches × 13·934 inches). The electro-magnets having been thus energized attract the pin floating in the mercury cup, the head of which pin in touching the carbon ring, *G*, of the contact block places the feed wire, *Q*, in circuit with the motors. The influence of this main current in addition to the accumulator current in the coils of the electro-magnets causes the magnets to exert an attraction varying with the amount of current required by the car. Between the carbon rings, *H* and *G*, there is consequently produced a pressure which increases with the strength of the current—a condition eminently favorable to the production of a perfect contact.

We have already described the arrangement of poles in the magnetic bars carried by the car. Referring to the diagram of the circuit, it will be seen that the central bar is in contact with the soft iron plug, *C*; and that the outer bars are located above the wings of the casting, *M*. By reason of this arrangement an induced magnetism is excited by means of which it is possible to obtain the highest utilization of the magnetic force which actuates the pin, and to reduce to a minimum the consumption of current necessary to the working of the apparatus. The pin is always attracted when the car is over the contacts; this arrangement being rendered necessary especially during the evening, for if the pin were to drop, the circuit would be broken and the car plunged in darkness.

PLEA FOR A WORKING STANDARD OF LIGHT.

By S. EVERETT DOANE.*

IT was my desire to present what I am about to say as a part of the discussion on the report of the committee on the standard of light. As this committe will not report at this meeting, I bring the following before the Institute, with no intention, of course, of interfering with the work our committee is doing. We all agree as to the importance of this work. What I wish to propose is that this committee or a new one fix definitely the means for maintaining a working standard of light pending the adoption of a primary one.

There are scattered over the country many well equipped laboratories, and in the near future every central station and large isolated plant will be provided with means for measuring light. There is not now in existence any workable primary standard which can be used by the ordinary photometer corps.

It may be said that this is equally true of all primary standards. The mercury column or resistance standard, in fact, presents so many difficulties that it is rarely ever used, even in our best equipped laboratories. In reply we can say that the standard of light differs from all these in that its terms are so indefinite and so crudely outlined that two laboratories cannot produce the same value for the candle power, if they work entirely independently. The discussion on this paper will probably bring out very diverse views as to what is the proper direction in which to work to eliminate our present difficulties with the light standard.

The standard of light is in quite another class from the other standards. Every instrument maker is anxious that his instruments shall be calibrated in true units, and he can so calibrate them if he uses care. He sends his instruments out so calibrated to the best of his knowledge.

A lamp user may say to the manufacturer, "Your standard is wrong," and neither ever dreams of suggesting a recalibration; they know by experience that an agreement cannot be reached. No observer can even duplicate his own work. What is the result? Every lamp maker in the country is sending out some lamps which are wrongly marked according to his own standards because some of his customers have standards of their own.

Lamp makers differ among themselves, and there exists no way by which they can be brought together. It is obviously to the interest of the whole electrical engineering fraternity that some action looking to the correction of this condition be inaugurated.

In passing I wish to go on record as saying that in a very few years the incandescent lamp will be adopted as a primary standard. It could be so adopted to-day if lamp makers would only tell what they know.

Every committee (our committee included) ever having to do with investigation of proposed light standards has found an incandescent electric lamp a very convenient secondary standard. It has been entirely satisfactory, so much so that my whole purpose in writing this paper has been to see if we cannot inaugurate some action which will result in the appointment of a committee who will provide means whereby a standard of light may be arbitrarily maintained. This committee could send out under proper restrictions properly seasoned and calibrated incandescent lamps for this purpose.

It does not matter just how this is done. Possibly a national laboratory could be founded. A committee of the professors of electrical engineering from our various colleges might agree to do this for us. Something should be done, and the first step toward it will be the appointment of an Institute committee on the maintenance of what our committee on light may decide is a proper standard value. Such a decision will be arbitrary and may have to be changed later, but what of that? We need now a common working standard of light.

That the discussion may be entirely free, I refrain from making any definite suggestions until the views of the members may be obtained; but whatever these views may prove to be, I hope some action will be taken which will afford us temporary relief, and enable our committee on light standard to pursue its work unhindered by the necessity for hasty action. We can take action none too soon. A year from now, at the rate photometers are being made, we shall have as many standards of light as Joseph's coat had colors, unless something be done.

LIQUID HYDROGEN.

THE second lecture in connection with the celebration of the Royal Institution's centenary was recently given at Albemarle Street, London, by Prof. Dewar, and the occasion will be remembered by all who were present as the first at which liquid hydrogen—at once the lightest and the coolest liquid ever known to exist—was seen outside the laboratory, and in such substantial quantities that vessels full of it were handed round for inspection. The Duke of Northumberland presided, and the numerous audience included most of the new honorary members, together with Lord Kelvin, Lord Rayleigh, Sir George Stokes, Sir Frederick Bramwell, Sir Edward Frankland, Sir William Crookes, Sir. J. W. Barry, Sir James Crichton-Browne, Sir W. H. Preece, Sir W. Roberts-Austen, Sir Frederick Abel, Sir Andrew Noble, Sir Alexander C. McKenzie, Sir

* A paper presented at the 16th General Meeting of the American Institute of Electrical Engineers, Boston, June 27, 1899.

Henry Mance, Dr. J. H. Gladstone, Mr. A. Siemens, Dr. Johnstone Stoney, and Dr. Ludwig Mond.

Prof. Dewar said he did not intend to take any long flight into the great work of the Royal Institution in the past, since that had already been done by his colleague. His object was rather to introduce his audience to a new instrument of research—that was to say, to liquid hydrogen. This he exhibited boiling gently in a vacuum tube immersed in liquid air, the access of heat being by this precaution greatly impeded. They would notice it was a transparent liquid, in which there appeared a whitish deposit. This consisted of solid air, and it was impossible to avoid its presence, because immediately the cotton wool plug was removed from a vessel of liquid hydrogen, the air of the atmosphere came under the influence of so low a temperature as to be at once frozen solid.

To prove that the liquid he was manipulating with such freedom was really liquid hydrogen, Prof. Dewar put a light to a small quantity, a brilliant burst of flame being the prompt result. Of its exceedingly small density he gave an idea by showing that a light material like cork would not float on its surface, but sank to the bottom as if it were lead. The lowness of its temperature he illustrated by a number of experiments. Thus, a solid body immersed in it for a short time was shown to become so cold that the air round it was liquefied, and ran off in drops, while, when a tube containing liquid air was plunged into it, the air immediately became solid. On this tube being filled out again a double effect was seen, for the melting of the solid within it yielded liquid air, which was also formed by condensation on its outside surface, an empty vessel placed for a short time in the cold atmosphere just above this liquid filled with solid air in the form of snow, soon melting into liquid. Oxygen in a sealed tube, when lowered into it, quickly became solid, and when lifted out it could be seen, as heat was absorbed, to assume first the liquid and then the gaseous form. A sponge of porous material, soaked in liquid hydrogen, and brought into a magnetic field, apparently behaved as if it were magnetic. That, however, was due to the condensation of the oxygen of the air, which, of course, was magnetic; and though an observer might in this way be easily deceived into thinking hydrogen magnetic, Prof. Dewar said he was satisfied that it was nearly neutral or diamagnetic.

Speaking of the real temperature of this liquid, he said it was 21° on the absolute scale. It had taken him nearly a year to come to a definite conclusion on that point because he could not get any two thermometers to agree. Pure platinum resistance thermometers gave 35° absolute (or 238° below zero Centigrade), one of platinum-rhodium alloy 27°, while hydrogen itself in a gas thermometer gave 21°, a reading nearly identical with one obtained with a German-silver electrical thermometer. The last part of the lecture was devoted to the extraordinarily low vacua obtainable by the use of liquid hydrogen. Thus by immersing one end of a closed tube in it for a short time, and then sealing it off in the middle, a vacuum was formed in the upper part which was substantially perfect, as was shown by the fact that the electrical charge could not be made to pass. In conclusion, Prof. Dewar, after exhibiting several other beautiful experiments, including one to illustrate the rapidity with which gases were discharged into a vacuum, claimed that the liquefaction of hydrogen was a triumph for theory not less than for practice.

Lord Kelvin, in moving a vote of thanks to Prof. Dewar for his brilliant, beautiful, and splendidly interesting lecture, said that if those present wished to measure the importance of the occasion, let them think what Count Rumford, or Davy, or Faraday would have thought, could they have been present. They could not have hoped for their scientific dreams and prophecies to be so splendidly verified within the century. The end of experiment in research at low temperatures had by no means been reached, and, perhaps, in a few years, substances yet unknown, and more refractory than hydrogen, would have been found which would bring the experimenter to within five degrees of the absolute zero.

The vote was seconded by Sir George Stokes and carried by acclamation.

Prof. Dewar, in reply, referred in appreciative terms to the part taken in the liquefaction of hydrogen by his assistant, Mr. Lennox. For himself, his chief function had been to get the wherewithal to carry on the experiments, and without the assistance he had received from numerous friends they would have been absolutely impossible.—London Times.

GLACIER WATER.

AN analysis of two samples of water from the Illecilliwaet Glacier, in British Columbia, was recently made by F. T. Shutt and A. T. Charron. The water was collected a few feet from the glacier's irregular face, about a mile and a half from the glacier station on the Canadian Pacific Railway. The following is abstracted from an account in The Chemical News:

	No. 1.	No. 2.
	Parts per	million.
Free ammonia	0·018	0·018
Albuminoid ammonia	0·027	0·037
Nitrogen as nitrates and nitrites	0·0246	0·0442
Oxygen absorbed in fifteen minutes	0·0396	0·0672
Oxygen absorbed in four hours	0·1056	0·1744
Chlorine	0·10	0·10
Total solids at 105° C	30·8	12·0
Solids after ignition	30·8	8·0
Loss on ignition	None.	4·0
Phosphates	None.	None.

The authors go on to say: "From the above data we may unhesitatingly conclude that the glacier water is one of great organic purity. The samples are not identical, due no doubt to the fact that they were collected twelve days apart, and probably from different parts of the foot of the glacier. Both analyses, however, show that, judged by the standards used in the diagnosis of ordinary potable waters, it is a water possessing a high degree of purity, and one perfectly wholesome and eminently suited for drinking and household purposes. As received, both samples were quite murky, almost milky in appearance. On allowing them to stand, perfect subsidence took place, leaving the supernatant water colorless and brilliant. A microscopic examination of the sediment showed it to consist of very fine rock matter, chiefly fragments of quartzite."—Popular Science Monthly.

THE NURAGHI OF SARDINIA AND SIMILAR STRUCTURES.

A MOST remarkable country, this Sardinia! It still seems to be wrapped in a deep slumber, absolutely unaffected by modern life and culture; and yet, this dreamy land possesses railroads—to be sure they do a very poor business—and the means of communication with the mainland by way of Italy are constantly improving. This condition of affairs is easily explained by the history of the country; even centuries ago, from the time when the Phœnicians first set foot on the land, and later under the Greeks, Etruscans and Romans, Sardinia was always looked upon as a land to be plundered for the benefit of strangers. The ancient inhabitants were driven from the fertile plains to the mountains, and so many of them were taken as slaves that "Sardivenales" (cheap as a Sardinian) became a by-word in Rome. But there was a time when the natives were far superior to their neighbors, as is proved by the number of monuments which still exist, after the lapse of so many thousands of years, to excite the wonder of all who visit the island, on account of their enormous size and of their number; we refer to the nuraghi, nurhags or nuragi, for the word is spelled in several different ways and various accounts of its origin have been given, but some of the latest authorities claim that it is simply a corruption of the Italian word "muraglia" (wall). On the island there are more than three thousand of these structures, towers having the form of truncated cones, which are composed of stones that were piled one upon another without cement. The stones at the base are of enormous size, but their proportions decrease somewhat as the wall becomes higher. In the lowest story is the entrance, which is generally so low that all who desire to enter are obliged to crawl in; but when this doorway has been passed, we find a high corridor leading to a round room which is usually about 16 feet in diameter and 23 feet in height. There may be a second room above this lower one, and frequently there is a third, each course of stone projecting a little beyond the one below it, so that each of the rooms has the shape of a dome which is closed at the top by a single heavy plate. The upper stories are reached by a passageway built in the wall, which is frequently a winding staircase, the end of which opens on the highest terrace. These structures, which are otherwise so different in detail that in spite of their great number it is impossible to find two that are exactly alike, are often 65 feet high and sometimes the walls are 50 feet thick. Occasionally a nuraghe stands alone, but this is frequently because the small nuraghi which formerly surrounded it have disappeared in the course of centuries; but there are a number of instances where the central nuraghe is surrounded by three or four small ones, and in rarer instances the several smaller nuraghi which surround the large central one are connected by walls.

FIG. 1.—NURAGHE IN SARDINIA.

There has been a great deal of discussion in regard to the purpose for which these nuraghi were originally constructed, but the fact that they were used partly as temples was established by the discovery of Prof. Vivanet, who, in 1878, excavated and most carefully examined the remains of a large nuraghe near the village of Teti; and La Marmora who first called attention to the nuraghi in his book, "Voyages en Sardaigne," was also inclined to believe that they were used as temples, because of the altar-like stones that be found in similar structures in Morocco (see Fig. 2, stone table at Trapucó), and of which he also found traces in Sardinia. It can also be claimed that they served as tombs—although very few remains have been found in them as yet—or that they were a kind of fortress, but Pais will not admit that they were dwellings, for he says that it is not probable that the Sardinians took the trouble to perform the immense amount of work required in the construction of the nuraghi simply to obtain poor, dark and badly ventilated rooms. He forgets that the requirements in regard to light and air have not always been the same, and that they must have been erected by a people whose first thought was for safety and who, consequently, did not consider the work as such. The fact that the nuraghi were really used as dwellings seems to be proved by the hints offered by similar structures which are still erected in many places in the south of Italy and on the Balearic Islands; in both of these regions the building of such structures, with pointed arches, of stone and without cement, is an art that has been practiced since the most remote times.

FIG. 2.—STONE TABLE AT TRAPUCÓ.

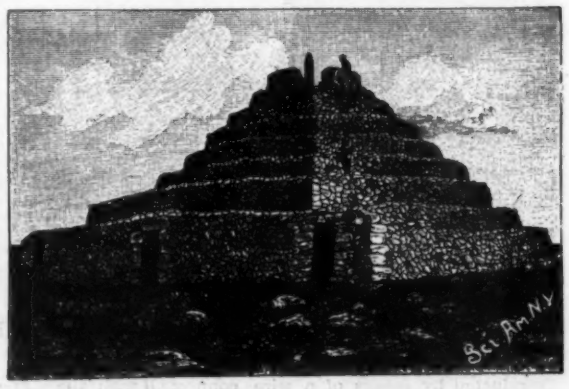


FIG. 3.—A BARRACA IN MINORCA.

In Apulia these buildings were called trudd[illegible] or caseddhe, while in Minorca they were known as barracas; a clear idea of the former can be obtained from one of our engravings (Fig. 4), which was taken from a model in the Prehistoric Museum in Rome; while another (Fig. 3) shows a barraca. Both of these

structures were built of single stones—large ones below and smaller ones above—piled up in a circle, each course, on the inside of the structure, projecting a little beyond that below it, so that the interior forms a pointed arch which is finally completed by a single stone. Both the truddhi and the barracas consist of several stories, and while the latter were used more for sheltering sheep and, in the upper stories, storing hay, the truddhi served as dwellings, although, as a rule, they were occupied only during the time of the hardest agricultural work; but our view of the city of Alberobello shows that these buildings were used as permanent dwellings in spite of the lack of windows and the inconveniently small entrance. Chimneys are, of course, a comparatively modern invention and not to be considered in connection with truddhi or similar buildings, which were apparently built originally for the purpose of clearing the ground of stones for pasturage and for agricultural purposes and, at the same time, rendering these piles useful.—Illustrirte Zeitung.

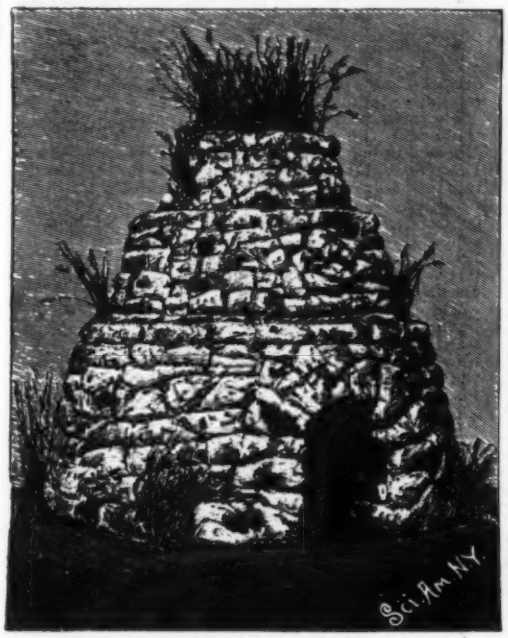


FIG. 4.—A MODEL OF A TRUDDHU.

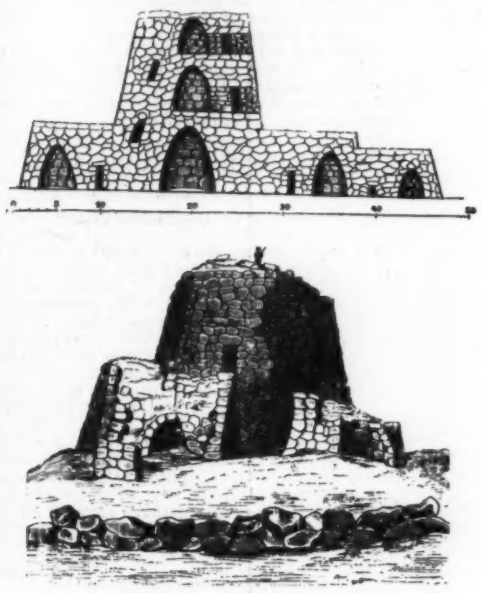


FIG. 5.—ELEVATION AND SECTION OF TWO NURAGHI.

THE DETERMINATION OF SOUND DIRECTION.

AMONG the many functions that have been attributed to the semicircular canals, that of the determination whence sounds proceed has received the support of some physiologists. Though the majority have strenuously denied this as one of their functions, some late experiments would seem to point to these canals as not wholly unconcerned in the perception of acoustic space. Their peculiar arrangement, occupying as they do three dimensions of space, is most seductive in the formation of theories bearing on our conception of space relationships. The objection was long ago pointed out that in the quadrumana, which lead a more or less topsy-turvy sort of a life, the respective relationship of these canals to the three dimensions of space must be constantly changing, and hence in these creatures at least they can have but little effect in the determination of space direction. Many fishes have only one or two semicircular canals. The lowest vertebrates have an ear not markedly different from the invertebrate type, as may be observed in the lamprey, which has a saccule with auditory hairs and otoliths in communication with two semicircular canals. The hag—myxine—has only one canal. The comparative studies of Dercum led him to give up all notion that these organs had anything to do with the maintenance of equilibrium or the determination of space direction. In spite of these various objections, the three prominent theories offered as explanation of the physiology of the perception of space direction point more or less to these canals.

The first theory is the crude one already mentioned and depending on the arrangement of the canals among themselves. As sounds all reach these canals through one and the same opening, it is difficult to imagine how their respective correspondence with the three dimensions of space can have any effect in the determination whence sounds proceed. This, in addition to the objections already enumerated, renders this crude though popular theory quite untenable. Another theory in regard to the perception of space direction of sounds assumes an acoustic space analogous to the tactual and visual space, and rests on the belief that special tactual sensibilities reside in the tympanic membrane. This theory is incomplete, however, in regard to an explanation as to how a mere surface such as the tympanic membrane can determine such complex relationships as are involved in the fundamental three dimensions of space. The association of the function of the tympanic surface with that of the canals would be rather more suggestive.

The third or motor theory assumes that certain motor impulses are awakened in particular definite relationships by the activity of the organ of hearing. The conception of the motor space is a derivative of past experience in connection with and under the influence of visual space and tactile experience. The existence of space-forms acquired through other sensations is presupposed in the conception of acoustic space. In connection with this theory it may be well to remember that, as Laborde pointed out, the auditory nerve contains both motor and sensory fibers, the former being distributed to the semicircular canals.

In some recent experiments made by Matatoro Matsumato, in Prof. Scripture's laboratory at Yale, many interesting phenomena were elicited. The subject was seated, blindfolded, with head in a headrest, surrounded by a kind of spherical cage so built that its axes furnished twenty-six terminal points. A short, sharp sound was made with a sort of telephonic apparatus at each of these terminal points, and fifty experiments were performed for each point. First of all it was most emphatically demonstrated that the perception of the direction whence sound comes is not a mere matter of chance. If it had been a matter of chance, probably not forty times in 1,000 would the judgments have been correct; as a fact, however, the judgments were correct 768 times in 1,000.

The four characteristics of sound waves are intensity, pitch, phase and timbre. Experimenting especially on the intensity of sound waves, Matsumato, who inclines to the motor theory in explanation of the appreciation of sound paths, without, however, referring to the semicircular canals, concludes generally that the relative difference between the intensities of the component sounds heard by the two ears is the immediate cause of the perception of the direction of the sound. The distance of the sound depends, on the contrary, on the absolute intensity of the sound.—Chicago Journal of the American Medical Association.

FIG. 6.—THE CITY OF ALBEROBELLO, NEAR BARI.

SOME EXPERIMENTS IN MAKING RUBBER SUBSTITUTES.

SINCE India rubber first became of value through vulcanization it has been the dream of experimenters and inventors to produce it artificially. One of the most persistent seekers after a substitute for the natural gum was the late Austin G. Day, who tried hundreds of experiments and took out many patents. He was in a measure successful, his "Kerite" compound proving of great value and being a result of his seeking for something that would wholly supplant rubber. As far back as 1866 he made public the results of some of his work, giving as formulas for rubber substitutes the following compounds:

No. 1.

Linseed oil	2 pounds.
Cottonseed oil	1 "
Petroleum	2 "
Raw turpentine	2 "
Sulphur	2 "

[Boil 2 hours.]

No. 2.

Linseed oil	2 pounds.
Cottonseed oil	1 "
Petroleum	1 "
Raw turpentine	2 "
Castor oil	1 "
Sulphur	2 "

[Boil ½ hour.]

No. 3.

Linseed oil	2 pounds.
Cottonseed oil	1 "
Petroleum	1 "
Raw turpentine	½ "
Liquid coal tar	3 "
Peanut oil	1 "
Spirits turpentine	1 "
Sulphur	4 "

[Boil 35 minutes.]

No. 4.

Linseed oil	2 pounds.
Cottonseed oil	1 "
Petroleum	2 "
Raw turpentine	½ "
Liquid coal tar	2 "
Spirits turpentine	1 "
Rubber	½ "
Sulphur	2 "

[Boil 1 hour.]

In 1871 Mr. Day had brought his experimenting down to the following formula:

Cottonseed oil	14 pounds.
Linseed oil	14 "
Asphaltum	8 "
Coal tar	8 "
Sulphur	10 "
Camphor	½ "

In this the tar and asphaltum were first mixed with the cottonseed oil, after which was added the linseed oil and camphor, and, last of all, the sulphur, when the temperature was about 270° F.

A substitute designed to be used in rubber compounding in place say of reclaimed rubber was made as follows:

Cottonseed oil	27 pounds.
Coal tar	30 "
Earthy matter	5 "

—to be mixed and heated to 300° F., and then strained and cooled to 200° F. Then were added 27 pounds linseed oil, the heat raised to 220° F., and 15 to 18 pounds of sulphur added, the heat being continually raised

until the mass was sulphurized. When the heat reached 240° F., 1 to 1½ ounces of nitric acid was added, and at 270° to 280° F., from 1 to 3 ounces camphor was added to help the sulphurization. The resultant compound was used on the following basis:

Para rubber	20 pounds.
Litharge	5 "
Sulphur	1 "
Above compound	20 to 40 "

Mr. Day, however, did not insist on the compound quoted, but advised that the proportions be varied as widely as the exigencies of the case might demand. Whiting, barytes, infusorial earth, white lead, blacks, in fact, almost any of the oxides, carbonates, or earthy materials commonly used in compounding, were used in connection with his substitute, as also were any grades of crude rubber. Among other ingredients that he found of use in making his substitutes were vegetable and animal waxes, together with ozokerite and paraffine. These, however, were only used in small quantities, and always in connection with the linseed and cottonseed oils, and generally asphaltum or coal tar. One of his compounds also called for a quantity of golden sulphuret of antimony, presumably to assist in the sulphurization, and a small amount of tannic acid.

The record of Mr. Day's years of experimenting, unfortunately, is imperfect. Were it complete, it would show that he drew upon almost all the ingredients then accessible, and that some of the results reached were very curious, and numbers of them of great value.

Another line of experimenting that is interesting, and that will yet produce good results, although so far it has not amounted to much, is in the use of cellulose. A very simple formula is of French origin and calls for the treating of cellulose with sulphuric acid, washing, drying, granulating, treating with resinate of soda —which is afterward precipitated by sulphate of alumina—then drying and molding under pressure. As a matter of fact, the resultant mass would not be mistaken for rubber. An English formula is more like it. This consists of:

Cellulose	15 pounds.
Pitch	25 "
Asphalt	20 "
Silica	20 "
Mastic	5 "
Bitumen	5 "
Resin	10 "
Coal tar	12 "

This makes a thick gummy varnish, which is of little use except as for its waterproof qualities. Allen's formula for a cellulose substitute might have a value if it were carried further. It is made up of 100 pounds of resinous wood pulp treated with animal gelatine, 100 pounds asphalt, and 10 pounds asphalt oil, all heated and molded.

The Greening process, which is English, is more elaborate than Allen's, but seems a bit laborious and costly. This process calls for the treatment of the cellulose by a mixture of sulphuric acid and nitrate of potash, and, after drying, a treatment to a bath of liquid carbonic acid. When dry again, it is mixed in a retort with refined resin, gum benzoin, castor oil, and methylated alcohol. The distillate from this is dried by redistilling over anhydrous lime.

Another curious line of substitutes is that based upon the use of glue and glycerine. Some of these have uses, while others, that look very attractive, are of no use at all, for the simple reason that they will absorb water almost as readily as a dry sponge. The first of these is more than thirty years old and is said to be of French origin. The formula is:

Glue	4 pounds.
Glycerine	8 ounces.
Nut gall	3 "
Acetic acid	1 pound in 5 pounds of water.

Ten years later this was approached by an English formula in which in place of the nut gall and acetic acid, chromic and tannic acids were substituted, and a modicum of ground cork was added as a cheapener probably. Some four years later an ingenious Prussian gave out a formula in which to the glue and glycerine and tannic acid were added Marseilles soap and linseed oil. None of the above have ever had a commercial value, the nearest approach being the glue and glycerine compound used as a cover for gas tubing.

The substitutes that have really come into use generally are made either from linseed, cottonseed, or maize oil. Scores of these have been produced and thousands of dollars have been spent by promoters and owners in trying to make these gums do just what crude rubber will. A German formula that cost certain American investors thousands of dollars, and which for a time looked as if it was going to be generally adopted, was:

Linseed oil	80 pounds	in solution.
Lime hardened resin	50 "	
Sulphur	8 "	add to above.
Linseed oil	42 "	

Add 20 pounds sulphur and heat to 375° F.

This gum, although used quite largely at one time in the United States, France, and Germany, is not manufactured now.

W. Lascelles-Scott, a distinguished English chemist, when on a visit to the United States to examine the Keely motor, called the attention of the writer to some very interesting formulas of his own for the manufacture of substitutes. For example, his soap substitutes certainly were original. They were:

No. 1.

Linseed oil	28 pounds.
Sulphur	8 "
Aluminum soap	28 "
Oil of turpentine	4 "

No. 2.

Aluminum soap	15 pounds.
Almadina	25 "
Caoutchouc	50 "
Sulphur	6 "
Oleum succini	4 "

In others he mixed reclaimed rubber dust with hardened resin, and bitumen; also with precipitated cellulose. One of the most interesting was a compound of linseed oil, sulphur, mineral caoutchouc, and Russian petroleum. Whether or not any of these are in use it is impossible to state. There are, however, hundreds of tons of rubber substitutes sold and used annually. About one-half of what is used is made in the factories for private consumption. The other half is manufactured for the trade by supply houses. As a rule this is made of one of the three oils named above, and may be generally divided into two grades: (1) the brown (or black) and (2) the white. The former is made by heating one of the fatty oils with sulphur; the latter is made by treating the oil cold with sulphur chloride. The substitutes on the market vary somewhat, of course, as they may be made from raw oil, or from "blown" oil, or it may be that the purchaser gets an oil that has been adulterated without his knowledge, which will make a difference in the product. As a rule, however, those who are furnishing the trade are giving a good article. At any rate, it is certain that more progress has been made in the direction of a good, safe substitute in the last three years than in the twenty years preceding.—India Rubber World.

A THREE-COLOR PROCESS.

By C. FLECK.

ALTHOUGH three-color printing lacks to-day in scientific and technical perfection, its practical application arrived at a much earlier date than was expected by prominent authorities. Germany and Austria chiefly make use of it for the production of illuminated post cards, which curiously enough have not yet caught on with the British public. Since productions in three colors command fair prices, the process has found its way not only into large establishments, but also into business houses of modest pretensions, though in the latter case many difficulties arise from the lack of sufficient specific knowledge on the part of principal and employes.

It is the purpose of this paper to describe a three-color method which, although not perfect, yet reduces the necessary amount of fine etching to a minimum.

We prepare seven solutions, four of which are used for color screens, the remaining three serving as dyes for the plates.

A.—SCREEN SOLUTIONS.

1. Blue violet.	Methylen blue	5 grammes.
	Tetraethyl diamido-oxytriphenyl carbinol	2 "
	(Or) Methyl violet	5 "
	Alcohol	200 c. cm.
	Water (dist.)	300 "
2. Green.	Malachite green	10 grammes.
	Alcohol	200 c. cm.
	Water (dist.)	300 "
3. Yellow.	Acridin yellow N. O.	10 grammes.
	Alcohol	200 c. cm.
	Water (dist.)	300 "
4. Red.	Congo-rubin	10 grammes.
	Alcohol	200 c. cm.
	Water (dist.)	300 "

B.—DYES (STOCK SOLUTIONS).

1.	Acridin yellow or acridin orange N. O.	1 gramme.
	Alcohol	100 c. cm.
	Water (dist.)	400 "
2.	Congo rubin	1 gramme.
	Alcohol	100 c. cm.
	Water (dist.)	400 "
3.	Tetraethyl diamido-oxytriphenyl carbinol	1 gramme.
	Alcohol	100 c. cm.
	Water (dist.)	400 "

The screen solutions, after being filtered through paper filters into clean dishes, are utilized to bathe six clean glass plates previously coated with 2 per cent. raw collodion; we require one plate for blue violet, two plates for red, two plates for yellow, and one plate for green, which in order to obtain the screens are combined in the following way: Yellow and red plate, yellow and green plate. For special purposes the other red plate may be combined with the blue violet. Another method of preparing the screens is to add the saturated solutions drop by drop to a mixture of Canada balsam and 2 per cent. of castor oil and cement the glasses together. Those who consider the screens by the first method too transparent, coat the glass plates with a mixture of 2 to 3 per cent. raw collodion and 1 per cent. color solution. Others prefer gelatine screens, using:

Hard gelatine (Nelson's)	8 grammes.
Water	100 c. cm.
Absol. alcohol	10 "
Pigment	1 gramme.

which is poured over the carefully leveled and heated plate after having been filtered through flannel.

The collodion screens are cemented together by moistening the edges with Canada balsam (containing castor oil) and pressing the plates together in a printing frame, sometimes also binding the edges with strips of Japanese paper.

On the evening before the day of work, good dry plates of about 18° to 24° W. are dyed in the following solution:

Stock solution No. 1	16 c. cm.
Dist. water	100 "
Alcohol	5 "
Nitrate of silver (1·500	50 "
Ammonia	1-2 "

This bath sensitizes almost uninterruptedly to line A. The total sensitiveness is high, and the plate develops cleanly and fine. Blue sensitiveness is very much reduced, and the blue screen is used for exposure. As far as the author's recollection goes, the plate for the yellow color has never been color-sensitized, many operators using the commercial Vogel-Obernetter eosine silver plates made by Perutz, of Munich; others again only use ordinary dry plates with a blue violet screen. This is, however, a decided mistake, necessitating an immense amount of retouching, as otherwise it produces a green shade on differently colored objects of the print.

For the red color plate the dry plate is dyed in:

Stock solution No. 2	10 c. cm.
Dist. water	100 "
Nitrate of silver (1·500)	100 "
Ammonia	2 "

The resulting absorption band is closed until E, reaching from violet to red (over C). This red pigment was examined by Eder, who obtained very good results, using ammonia in the solution.

The corresponding screen is a combination of malachite green with acridin yellow or acridin orange N.O.

For the blue color plate the dye is made up as follows:

Stock solution No. 3	0·5-1 c. cm.
Dist. water	100 "
Nitrate of silver (1·500)	100 "
Ammonia	1-2 "

This dye is patented in Germany (D.R.P. 86,225 of 1896), yields a strong band, commencing at B, reaching to C ¾ D; since the orange screen used herewith necessitates a long exposure, the action seems to extend into the infra-red (beyond A).

As a rule, cyanine is used instead of the tetraethyl diamido-oxytriphenyl carbinol (H Cl salt), but the former is apt to produce fogged plates. Methyl violet or crystal violet has also been suggested.

Exposures should be made in direct sunlight or with artificial pure white light (acetylene); electric light is too variable.

The most suitable methods of reproduction are half tone, and the prototype methods described in the March number (1899) of The Photogram, also Turati's Isotypie. The greatest difficulty in three-color printing now-a-days is presented by the want of accurate printing. We must use the proper paper and pure fast colors; the inking rollers should be smooth, not too soft, and free from pores or weals. The blocks must be firmly fixed typehigh, otherwise they take color irregularly. A good printing machine is, of course, most essential.

To supplement the above working directions: After having kept the plates for two or three minutes (constantly moving the dish) in the dyes, they are removed into a dish containing filtered alcohol, which extracts the superfluous pigment. Plates thus treated dry much more rapidly, develop cleaner, and show no fogging.

Most of the above dyes may be obtained from the "Berliner Actiengesellschaft für Anilinfabrikation," the acridin only from the "Farbwerk Mühlheim, o/Main, vorm. A. Leonhard & Company." A. B. Fleming & Company supply excellent printing inks.—The Photogram. Translated by Schriftführer.

[Continued from SUPPLEMENT, No. 1230, page 19712.]

INCANDESCENT MANTLES.*

By VIVIAN B. LEWES, F.I.C., F.C.S.†

WITHIN the last few weeks confirmation has been given of Dr. Bunte's results by an extremely interesting paper communicated to the Royal Society by Mr. A. A. C. Swinton, in which he inclosed the luminous materials in a vacuum tube and subjected them to bombardment by means of cathode rays which would raise them to a very high temperature, as it is possible by such a method to melt platinum and glass and bring finely divided carbon to bright incandescence. The mantle to be experimented on was mounted on a platinum wire frame and placed between the two electrodes, so that as the electric current alternated and each electrode became in turn the cathode, the mantle was subjected on alternate sides to cathode ray bombardment. Experiments were made with mantles consisting entirely of ceria and thoria, both separate and mixed in different proportions, and in order to obtain accurate comparisons between the pure oxides and different mixtures, the mantles were made in patchwork, each mantle being made up of two or four sections separately impregnated with different solutions and then sewed together with impregnated cotton before being burnt.

With a compound mantle prepared in this way, composed one-half of pure thoria and the other half of a mixture of 99 per cent. thoria with 1 per cent. ceria, it was found that after exhaustion on starting the cathode discharge, the thoria plus ceria heated up to incandescence more rapidly, and on stopping the discharge, cooled more rapidly than the pure thoria. Further, when at full incandescence and observed through a dark glass, the thoria plus ceria was slightly more luminous than the pure thoria, though the difference was very small, probably not more than 5 per cent. Owing to the difficulty of obtaining a constant vacuum, accurate photometric measurements were not possible, but the amount of light under favorable conditions was roughly estimated as at least 150 candle power per square inch of incandescent surface, this being obtained with an expenditure of electrical energy in the secondary circuit of about 8,000 volts pressure of approximately 1 watt per candle. The amount of exhaustion suited to give the best results varied with the dimensions of the tube and the conditions mentioned in the paper, but was approximately about 0·00005 atmosphere, the maximum luminosity being obtained when the dark spaces of the two cathodes just crossed at the center of the bulb. Owing to the large amount of gas occluded by the mantle, a proper degree of permanent exhaustion was very difficult to arrive at and required continuous pumping for many hours with the cathode rays turned on at intervals.

Even then the conditions of maximum luminosity were exceedingly unstable, owing to the further liberation of occluded gas on the one hand and on the other to the rapid increase in the degree of exhaustion, owing to absorption of the residual gas by the electrodes. That such absorption probably took place in the aluminum electrodes and not in the mantle was demonstrated by other experiments with a tube in which there was no mantle, but only two electrodes of aluminum wire.

These experiments all point to the fact that the idea of a mixture of 99 per cent. thoria and 1 per cent. ceria having the peculiar power of converting heat rays into light while thoria and ceria alone have not this power, or at any rate only have it to a very limited extent, is not tenable, as otherwise the same difference would have been noticed when the materials were heated either in the carbon tube furnace or in the vacuum tube, and this undoubtedly gives great support to the second theory.

It has been pointed out that the amount of ceria in the mantle is so extremely small that it seems hardly credible that any surface action that it possessed would play an important part in the production of luminosity.

* Paper read before the Institution of Gas Engineers, on May 3.—From The Progressive Age.

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but Dr. Bunte answers this objection by saying that "according to Davy's theory, the illuminating power of an ordinary gas flame is due to particles of carbon which are separated from the gas and raised to a white heat. The carbon arises chiefly from the decomposition of the heavy hydro-carbons ethylene and benzene, which form together about 5 per cent. of the volume of the gas. Assuming for the sake of simplifying the calculation that all the carbon of the benzene and half that of the ethylene is separated and heated to incandescence in the flame, it may be calculated that about 54 milligrammes of carbon are separated from a liter of good coal gas (23·6 grains from 1 cubic foot). Thus 4 per cent. of ethylene and 1 per cent. of benzene gives per liter of gas 60 cubic centimeters of carbon vapor from the benzene and 40 cubic centimeters from the ethylene, in all 100 cubic centimeters, which is equivalent to about 54 milligrammes of carbon. The volume of the luminous portion of a flame having a consumption of 5·297 cubic feet per hour and an illuminating power of 17·5 candles is about 2 centimeters at 32° F. There is, therefore, in it $\frac{2 \times 54}{1{,}000}$ milligrammes or 0·1 milligramme = 0·0015 grain of incandescent carbon. Such an extremely small quantity of incandescent carbon as 0·0015 grain gives the luminous surface to the gas flame and emits a light of 17·5 candle power. Now the 1 per cent. of ceria in the Welsbach mantle amounts to about 4 milligrammes (0·06 grain) per mantle, or about forty times the quantity of incandescent carbon in an ordinary flat flame. The quantity is, therefore, quite sufficient to explain why the Welsbach burner may give a light of 60 candles while the flat flame or Argand burner furnishes only 17·5 candles."

The only other legalized mantle at present before the public is the Sunlight, the ingredients of which consist of alumina and the oxides of chromium, and it is interesting to see how far the light yielded by this mantle can be attributed to the same action as in the case of the Welsbach. If a mixture of alumina or alumina and zirconia with a very small percentage of chromium be employed, a very high candle power is produced, which, however, soon dies away, owing to the volatilization of the chromium compound, while if the amount of chromium present be increased, the mantle acquires a more ruddy light and retains its illuminating power for a much longer period, so that with a proper percentage of chromium a candle power of 10 to 11 candles per cubic foot of gas can be obtained for a period of 400 to 500 hours, and it is noticed that the chromium, which on first burning shows as green chromium oxide, rapidly combines with the alumina to form a pink compound which has much the same composition as the ruby, and it is quite probable that the increased life given by the larger quantity of chromium is due to the fact that the lighting power of the mantle is really dependent on small traces of the oxide of chromium, and that as this gradually volatilizes off from the surface of the mantle, some of the pink compound gets dissociated by heat and supplies a fresh portion of chromium oxide to the surface of the mantle, this pink compound being far less volatile than the chromium oxide itself.

Thoria, as far as the life of the mantle goes, is perhaps the most important constituent, as there is no other known oxide which will stand heat for so long a period without being affected by it, and the getting away from shrinkage in the mantle was one of the chief steps which led from the failure of the early mantles to the success achieved by the later ones.

Moreover, thoria is a body having a very low specific heat, and owing to its bulk when produced from the nitrate of thorium by the action of heat is a good non-conductor, so that the temperature created on the surface of the ceria particles is more readily localized there.

Within the last few years attempts have been made to attack the question of mantle making from a different standpoint. Admitting the superiority of thoria with its 1 per cent. of ceria over other mantle mixtures, efforts have been made to obtain mantles of filaments of this mixture upon the principle under which the old Clamond basket was made.

Clamond produced his incandescents by making a paste of magnesia with acetate of magnesia in solution, and moulded the mixture into threads by squeezing through holes in a plate, the threads while still moist and plastic being wound to the required shape on a mandrel or mould, the still moist threads being pressed together and made to cohere at the points where they crossed each other, and then on baking the acetate luting burnt to oxide and the coherent magnesia hood or basket remained.

The reduction in size of the filaments to be rendered incandescent was a great advance over the old lime light and enabled incandescence to be produced by a burner instead of a blowpipe, while Welsbach's discovery or rather adaptation of the principle of saturating a fabric and incinerating created a new era in incandescence by giving a degree of fineness not before approached.

As was natural, attempts were then made to reduce still further the size of the filaments in the Clamond basket, and on November 4, 1890, Lungren patented a distinct advance. It was found that if you made a plastic filament as Clamond had done, but finer in substance, it dried very quickly, and on attempting to make the material cohere at the crossing of the threads, those first wound on the mandrel, being drier than those wound across them, were harder, and on pressure being applied cut through the softer threads instead of welding with them. Finding this, Lungren patented the idea of making a plastic mass of some elastic material charged with refractory earths or metallic oxides, expressing from some such mass fine wires or threads, weaving or interlacing the threads into a fabric from which the cone or mantle could be made and then burning out the combustible elastic binder. In making this binder he gives mixtures of glue with glycerin, India rubber dissolved in naphtha or boiled linseed oil as examples, but also says that a variety of materials may be used.

One of the most remarkable developments of the last fifty years has been the wonderful way in which the lower form of guncotton, known as collodion cotton, has been utilized for commercial purposes, and at the present time it bids fair to invade the territory of incandescent mantle making. It was in 1838 that the chemist Pelouze drew attention to the fact that when paper was acted upon by the strongest nitric acid it increased in weight and acquired the property of burning with enormous rapidity, while as early as 1832 Braconnot had prepared a substance called "xyloidin" by acting upon starch, linen, and sawdust in the same way. It was not, however, until 1845 that any serious attention was directed to the use of such substances as explosives, when Schonbein first called attention to nitrated cotton wool and advocated its use as a substitute for gunpowder, showing that in explosive energy it was far superior to it.

Experiments were at once instituted on a large scale and its manufacture carried on in England and also on the Continent, but in 1847 a very serious explosion occurred at the works in which it was manufactured by the Messrs. Hall, at Faversham, while a year later an even more serious explosion followed in the guncotton factory at Bouchet, near Paris, and as no reason could be assigned for these and other similar explosions, guncotton was looked upon as too dangerous an explosive for ordinary use, and its manufacture was for a time discontinued.

During this brief period, however, it had been discovered that if the strength of the nitric acid employed in the manufacture were slightly reduced, a compound was formed which had the property of dissolving in a mixture of alcohol and ether, which was not the case with the true guncotton, and that on allowing the solvent to evaporate, a semi-transparent mass was left in which no trace of the structure of the original material remained. This solution was eminently adapted for forming thin films on glass plates, and as this was a great desideratum at this particular period for photographic purposes, the new material began to be manufactured on a fairly large scale. It was soon found that by slight modifications in the method of manufacture and by loading it with various foreign materials, excellent imitations of amber, ivory, and tortoise shell could be obtained, with the result that the manufacture of collodion has now attained considerable importance.

One of the most beautiful applications of collodion is the manufacture from it of artificial silk. In the interesting but little known town of Besançon, the French inventor Chardonet has established a manufactory in which collodion made by nitrating wood pulp is dissolved in the smallest possible quantity of alcohol and ether, and the emulsion is then squeezed out under a pressure of 750 pounds to the square inch through capillary glass tubes, the clear way of which is less than one-hundredth of a millimeter, this enormous pressure being required to cause the material to flow evenly through the excessively small apertures. The filaments of from ten to twelve of these tubes are then twisted and wound on to a bobbin in a machine of the same character as used for the spinning of silk fiber. The air of the room in which this operation is carried out is kept at a sufficiently high temperature to cause the instantaneous setting of the filaments owing to the evaporation of the alcohol and ether, so that within three or four inches of the tube from which the material is issuing it has lost all stickiness and may be twisted without cohesion between the threads. These threads have all the appearance of silk, but have one serious drawback, that being practically a low form of guncotton, they are excessively inflammable and burn with a violence only a little removed from that of true guncotton. In order to overcome this trouble, the skeins of artificial silk are soaked in ammonic sulphide, which has the effect of what is termed "denitrating" them and converting them once more into cellulose, so that after washing and drying the material is not more inflammable than an ordinary fabric. This material is capable of taking every shade that the dyer's art can impart to it and forms a most beautiful and wonderful imitation of silk, lacking only to a slight degree the elasticity found in the original article.

This extremely beautiful process was brought to perfection by Chardonet and protected by him during the period which extended between 1886 and 1893, and in 1894 De Mare took out a patent for making incandescent filaments by charging collodion with metallic salts and oxides, squeezing into threads, weaving, and burning. In this patent, however, he makes no mention of denitrating the collodion filaments before burning, which would make it extremely difficult to make a mantle according to his patent.

In 1895 Knoffler patented the manufacture and denitration of collodion threads or filaments loaded with oxides or salts, and in his first claim mentions that the filaments may be "individual or spun and eventually wrought or woven threads which are made after the manner of the so-called artificial silk."

Later on Plaissetty took out a patent which differs from Knoffler's only in that he uses glacial acetic acid as the solvent for his collodion cotton, and instead of denitrating with ammonic sulphide, uses a solution of sulphide of lime, which, however, has the drawback of leaving a trace of lime as an impurity in the finished mantle.

Mantles made by such methods as those devised by Knoffler and Plaissetty are developments of the Clamond hood and not of the Auer mantle, the difference being that whereas the Clamond class consists of filaments of even density made by squeezing a plastic material into rods or threads which, after the binding material is burned off, leave a uniform mass of oxide, the Auer class consists of filaments having a dense central portion surrounded by a more or less spongy coating, due to the fact that the soaked fabric on burning off leaves the oxides produced from the interior of the capillaries in a dense state while the salt on the exterior of the cotton in its conversion into oxide by heat is rendered spongy by the escape through it of the gaseous products of the combustion of the cotton, so that if a section of one of the filaments constituting a strand could be examined under the microscope, the appearance would be somewhat as described. The physical effect of this on the mantle is that the Clamond class is harder than the Auer and does not show the same high incandescence until the surface of the filaments has become eroded by burning for a short period, the life of the Clamond class when made of the same material as the Auer, however, being longer. For instance, two mantles made one by the Plaissetty and one by the Auer method so as to yield an ash containing 99 per cent. thoria and 1 per cent. ceria would give curves of the following character:

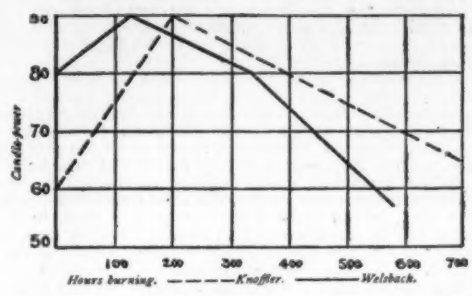

FIG. 2.—ENDURANCE OF WELSBACH AND KNOFFLER MANTLES COMPARED.

The total life of the Knoffler and Plaissetty mantles being probably a third longer than that of the Auer.

There seems every probability that mantles of Knoffler and Plaissetty type will play an important part in incandescent lighting, as in Paris the Welsbach Company has acquired the patent rights of the process and is introducing an innovation upon it. On taking a collodion mantle and heating it in a drying oven for a certain length of time, a considerable shrinkage takes place, and if this shrunken mantle is then placed on a burner and burnt off, the fabric rapidly moulds itself to the form of the flame with but little manipulative aid. For street lighting and for maintenance work it would manifestly be a great convenience to do away with the collodionizing altogether, which always to a certain extent impairs the light-giving power of the mantle.

Another new feature which has been introduced into mantles of this class is the doing away with the asbestos thread and loop, which has always been a weakness in the fabric, and to make the strangulation at the top of the mantle by sewing it around with fibers of the same character as those of which the mantle itself is made, this constricted annulus then resting upon a supporting ring which is fixed as the ordinary support in the center of the mantle.

The asbestos thread has always weakened the top of the mantle, owing to the difference in the rate of contraction during burning off, and with a mantle merely resting on a supporting ring in this way you get what really is an anti-vibrating arrangement which materially enhances the life of the mantle for outside work.

The matter which I have brought before you has already occupied so much time that I do not propose to go into the question of burners. Many highly vaunted improvements have been introduced during the last two years, but they have all been based upon the idea first introduced by Bandsept of getting the proper admixture of the maximum of air and gas to be burnt at the bottom of the burner and completing and perfecting the mixture close to the mouth of the burner where the combustion is to take place.

In many cases the increased luminosity given by such burners is really due to the length of tube, the increase of which acts in the same way as increase in gas pressure. These improved burners have shown themselves to be extremely variable, as while with carefully adjusted samples and careful manipulation in the laboratory it has been possible to get as much as twenty-five candles per foot of gas with a properly prepared Welsbach mantle, yet in practice on a big scale the duty given is quite as often seventeen candles or less, and the old Bandsept burner, when properly made, is still as good as or better than any of the new ones.

PUNCTURE FLUIDS FOR THE PNEUMATIC TIRE.*

Now that a certain company have come to the front with the statement that they are the original and only patentees of fluids for puncture-closing in pneumatic tires, it may be of interest briefly to review the different liquids that have been put upon the market.

To begin, it may be well to state that American manufacturers of tires are very far from being favorable to this type of tire repairing, the chief objection being that some of these liquids form a coating on the inside of the tire which keeps a patch from adhering when a serious puncture is to be treated. It must be remembered that most of them manufacture their own repair kits, which they prefer to sell rather than to keep in stock while the puncture fluid sells.

A leading tire manufacturer, under the heading of "Anti-Leaks," writes: "Beware of all so-called healing mixtures. It has been known by every maker of bicycle tires for years that sticky compounds on the inside of the tire would close small holes. It has also been known that the majority of these compounds prevent permanent repairs when a repair becomes necessary. Every one of these compounds has been put on the market by concerns having little or no connection with the rubber business, and in nearly every case the effect on the tires is hurtful. It is quite possible that the compounds do not contain anything that is actually injurious to the rubber; but they almost invariably contain something that prevents the cement from holding firmly when it becomes necessary to cement a patch in, or to prevent the tire from being cleaned thoroughly when it is necessary to vulcanize. Many of the compounds also contain materials that are positively injurious to the rubber and completely ruin the tire in a short time. Owing to this, we have adopted a general rule, and our guarantee does not apply to tires which have been treated with these compounds."

On the other hand, no less a concern than the Dunlop Pneumatic Tire Company, in 1898, brought out what they called the "Dunlop Puncture Stop," which they thus describe: "It consists of a viscous but not oily fluid, which is injected into the inner tube. In this fluid there are suspended numerous small granular

* From the India Rubber World, New York.

particles, and when a puncture occurs, one or more of these small granular particles, in an endeavor to escape, is conveyed to the aperture, which it promptly closes. By this means pin-pricks, thorn punctures, and all small injuries to the inner tube are automatically cured. The rarer kind of injury, such as bad cuts from glass bottles or other sources of severe damage, will not be closed by the 'Puncture Stop,' as the incision in such cases is too large for the granular particles to fill up; but such wounds must be patched with rubber in the ordinary way, with one additional precaution—namely, that the 'Puncture Stop' must be worked away from the seat of injury inside the tube before solution is applied to the surface of the tube. The patch will not adhere where the tube is moistened with the stop, which must therefore be removed, in the same way as it is necessary to remove the gray deposit from the air tube whenever an ordinary repair is executed. The 'Puncture Stop' is not an infallible preventive of all tire injuries, but is an automatic healer of a very large percentage of them."

In spite of both the praise and the blame, the puncture fluid held its own, and as many as forty different kinds appeared on the market. These were known by distinctive names, such as "Never-leak Tire Fluid," "Cyco," "Lightning Fluid," "Poppin Tire Healer," "Liquid Rubber," etc.

The compounds themselves were mostly of the glue and glycerine type. One, for instance, was made of glycerine, a farinaceous substance, a metallic oxide, and graphite; another consisted of glucose, flour, gum arabic, and water; another of graphite, powdered asbestos, whiting, and glycerine; another of dextrine, boracic acid, caramel, and water; another of glucose and glycerine and minute vegetable seeds; another of glycerine, fuller's earth, and plumbago, and so on.

The foregoing were all American inventions. Typical English formulas called in one case for sugar, starch, water, and coloring matter; in another for pyroxylin, dissolved in amylic alcohol with the addition of glycerine or molasses; another for glue, glycerine, water, and chloroform; another for melted India rubber, chalk, meal, and glycerine.

Three out of several Swiss liquids call for the following: (1) Ammonic gum, resin, water, and glycerine; (2) silicate of soda, sugar, and dextrine; (3) gum, galbanum, India rubber, glycerine, and water.

It will be noted that almost all of these depend upon glycerine as the viscous agent in stopping the puncture. Rubber manufacturers, that is, those who have made tires, have claimed that in any such compound, where a large amount of glycerine was present, the effect was to soften the inner coating of the tire. On the other hand, if glue was very abundant, it dried, forming a stiff crackling coat. As a matter of fact, few of the fluids that have been put on the market have been at all harmful to a good grade of rubber. They have, however, made it difficult for repairers to do good work many times. Those who have had the greatest cause of complaint, and who are sincerely opposed to puncture fluids of any and all kinds, are the manufacturers of reclaimed stock, made from pneumatic tires, as it has been impossible to put tires through a preliminary grinding until the fluid has been dissolved out, usually by a hot alkaline solution. The fact that the tires must be chopped in pieces by hand, and then treated to a bath before the beginning of the grinding for recovery, has turned these manufacturers into the strongest kind of opponents of any and all puncture fluids.

The patent upon which the Buffalo Specialty Company base their claims for protection as being the original and only authorized manufacturers of puncture fluids for tires was issued March 9, 1897 (No. 578,551), to Charles A. Duryea, Peoria, Ill., and assigned to the Indiana Rubber and Insulated Wire Company (Marion, Ind.), the original application being filed December 28, 1891. In the patent are seven claims, which cover a pneumatic tire, provided with a semi-liquid or a free-flowing sealing agent or cement within its air chamber, designed to flow within the tube and by the movement of the tube adapted to be forced by escaping air into leaks or apertures, and to coagulate when exposed to external atmosphere, and thus seal the puncture. It will be seen that, if this patent is sustained, any semi-liquid or cement used in the manner described is an infringement. It is due to other puncture fluid manufacturers to say, however, that in spite of the confidence that the specialty company show, they do not seem to feel at all anxious.

Discoveries were made recently in the lava beds of New Mexico, some of which are situated eighteen miles west of Santa Fé, which prove that thousands of years ago there existed in New Mexico a system of reservoirs and irrigation viaducts that is unparalleled at this age. Under the lava, which covers hundreds of square miles, are found traces of cemented ditches and reservoirs that are marvels of civil engineering. Irrigation engineers have much to learn from the people, older than the Pueblo race, who inhabited New Mexico when the race from which Columbus sprang were still barbarians. The ancients provided against seepage by cementing the bottoms of their ditches wherever they are conducted across loose soils. Their ditches wound in and out at the base of mountain ranges, following the sinuosities of canyons and rounding points in such a manner as to catch all the storm water before it was absorbed by the loose sands at the mountain's base. Reservoirs at convenient basins stored the water, which was led in cemented ditches across the loose soils to where it was needed for use. Chasms were crossed by viaducts, and wonderful engineering devices were used for the removal of silt that might be used as an aid to the fertility of loose and rocky soils otherwise valueless. Into some of the ditches lava has run, showing their great antiquity. Others are now covered with shifting sands, but enough are still visible in many places in New Mexico to enable the skilled engineer to understand the system which pre-historic New Mexicans rendered so effective.—N. Y. Tribune.

The New York Board of Health has recently made an exhaustive examination of the samples of candy purchased throughout the city, chiefly from stands and shops near public schools. Contrary to what might be expected, the samples which were examined did not prove to be very injurious; they were largely composed of starch, gum, and glucose.

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